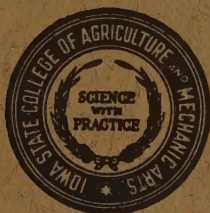


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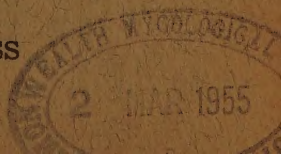
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THE GRASSHOPPERS AND OTHER ORTHOPTERA OF IOWA¹

Richard C. Froeschner

Department of Zoology and Entomology
Iowa State College, Ames, Iowa

PREFACE

Some of the most destructive insects belong to the order Orthoptera. They not only compete with man, sometimes all too successfully, for his field and garden crops, but also invade his buildings where they contaminate and destroy food and stored products, and in some instances actually serve as carriers of disease.

Most of the serious damage to field crops in Iowa results from the activities of a very few species, the most important of which are the migratory grasshopper, Melanoplus mexicanus, the differential grasshopper, Melanoplus differentialis, the two-striped grasshopper, Melanoplus bivitatus, and the red-legged grasshopper, Melanoplus femur-rubrum. These four are native species with similar life cycles and habits, so that all are often active in a limited area. All pass the winter as eggs deposited in soil during the previous fall. The wingless young grasshoppers emerge from the egg in spring, and after depleting nearby food supplies wander off in search of more. It is at this time that they move into the concentrated food sources offered by cultivated crops and cause their damage through voracious feeding. They begin reaching adulthood by summer, and the females then lay their eggs in the soil before natural death or frosts kill them. However, in some favorable seasons the migratory grasshopper practically completes two generations.

In Iowa, the history of grasshopper or "locust" damage extends back into prehistoric time, if one can accept the inference of Indian legends. Early explorers and settlers in the region often reported mass flights of enormous numbers of grasshoppers which denuded the land of plant life almost as completely as did prairie fires. The early settler, thus deprived of food for himself and his meat and draft animals, was reduced to dire poverty - often being left without seed for the following season. Even the wild animals of the region which furnished him with flesh for food and hides for clothing and leather moved away to search for food plants in other areas or died of starvation.

Such destructive occurrences resulted from the migration flights of vast numbers of a single species, the migratory grasshopper. The breeding area for such uncountable numbers centered in the plateau region of Rocky Mountains in Colorado, Montana, Wyoming, and southern Canada.

¹Journal paper No. J-2579 of the Iowa Agricultural Experiment Station, Ames, Iowa. Projects No. 650 and 1099.

From this area the grasshoppers flew in great swarms for distances up to 2,000 miles.

Very early travellers, such as Johnathan Carver in 1776, reported large swarms of grasshoppers in the area and that a popular designation of "locust years" was given to those seasons when grasshoppers appeared in large numbers. Due to the relatively unpopulated condition of Iowa during the first half of the 1800's few written records remain to tell of the grasshopper plagues which visited Iowa in those years when they were wreaking destruction on settlements in neighboring areas.

At the beginning of the last half of the 1800's the frequency of occurrence of grasshopper swarms and the amount of damage caused began to increase. During the period from 1885 to 1887 large flights moved into the western half of the state. These swarms consumed much vegetation and laid great numbers of eggs, so that the following season found not only new grasshopper invasions but also progeny from those of the previous year. In the growing seasons of 1867, 1868, and 1873 to 1877, grasshopper plagues reached their most destructive peaks in Iowa history. The invading hordes came into Iowa from the west, their direction of flight being a little south of east and at the rate of eight or more miles per hour. The insects were at times so thick as to darken the sun; in one instance near Red Oak they settled in such vast numbers that the railroad trains were stopped by the oiling of the track with their crushed bodies. The grasshoppers attacked corn, grains, gardens, and nurseries as well as native plants, and during some seasons destroyed as much as three-fourths of all crops in certain of the western counties of the state. By 1878 the peak of grasshopper invasions had passed and only small swarms were reported in a few of the western counties.

Since that time the migrating masses have almost or quite disappeared, and in their stead have appeared periodic outbreaks of large numbers of native grasshoppers which had developed locally.

During the 1880's and 1890's these native grasshoppers appeared conspicuously in most parts of the state, but did only local damage. They appeared in numbers again in 1910 and 1911, and during the latter year caused considerable damage to cultivated plants in many parts of the state. It was not until 1917 and 1918 and again in 1921 and 1922 that grasshoppers once more reached sufficient abundance to cause important economic losses to Iowa agriculture. By the latter period, however, agriculturalists had begun using a sweetened poisoned bait upon which the grasshoppers fed by preference. They were thus killed before they could cause excessive damage to crops.

Iowa's period of greatest destruction resulting from activities of native grasshoppers occurred during the 1930's. The first sign of trouble appeared in 1931 and 1932 when several of the eastern counties suffered considerable damage. With the coming of the hot, dry spring and summer of 1936, the vegetation, which clothed the sites where eggs had been laid along roadsides and in fence rows, was insufficient to meet the food requirements of the young grasshoppers. As soon as this source of food was depleted the grasshoppers converged in great numbers on cultivated plants in adjacent fields. Pastures were eaten to the bare ground, field crops, such as corn, clovers, oats, soy beans, and others, were devastated; and home and truck gardens and orchards were also invaded and

often seriously damaged. An estimated loss of 25 million dollars resulted in Iowa that year. Ninety per cent of this damage was done by the four species of Melanoplus listed above.

This abundance of grasshoppers carried over into the spring of 1937 when "nymphal populations of 200 to 500 or even over 1,000 per square yard were not at all uncommon." Although weather early in the season was unfavorable to the grasshoppers and resulted in a heavy mortality, later weather conditions were more favorable so that by the fall of that year the number of eggs in the soil gave a threat of heavier and more widespread infestation than had occurred at any other time during the decade.

Fortunately, this serious threat did not materialize. The seasons of 1938 and subsequent years were unfavorable to grasshopper survival and development, and consequently all but the western part of the state had little or no serious damage from these insects. Where local conditions did result in destructive numbers of grasshoppers the proper use of poisoned baits gave practical control.

No extensive local outbreaks have occurred in recent years, but this gives no assurance that a series of favorable seasons might not again result in the appearance of destructive numbers. But even if such did materialize, the chances for effective control are greater due to the appearance of several of the newer insecticides which are very effective against these insects and are more easily and readily applied than was the poisoned bait.

Home gardens are subject not only to the attack of the grasshoppers mentioned above, but also to crickets and katydids. These latter, because they hide during the day and work at night, are often overlooked as a source of damage to growing plants. The crickets sometimes wander into houses where they have been known to cause some damage by eating fabrics.

No housewife needs to be convinced that cockroaches in the home cause considerable damage by their feeding habits and by imparting a "roachy" odor to food and other products. These insects are responsible for expensive losses of food, clothing, and other household furnishings. In addition, cockroaches are proven carriers of pathogenic bacteria of man and animals, and are known to serve as hosts for parasitic worms of man and animals.

But not all members of the order Orthoptera are undesirable. The praying mantids or devil's-rear-horses, while not so common in Iowa, can be considered as allies. They feed on other insects, including flies and frequently grasshoppers. Some of the grasshoppers, katydids, and others that restrict their feeding to unwanted weeds may be considered beneficial, while other forms are so few in numbers or have feeding habits such that they neither help nor hinder man in his efforts to obtain a living.

In the balance of nature the Orthoptera hold a very important position. They serve as food for an inestimable number of higher animals. For example, more than one hundred species of birds are known to feed on them; skunks, moles, shrews, toads, and snakes also eat them in considerable numbers. Thus they become of great importance to the conservationist who is interested in an abundance of food for wildlife.

Thus it is evident that many phases of human existence are directly affected by the activities of representatives of the order Orthoptera.

INTRODUCTION

In establishing our present system of animal classification in 1758, Carolus Linnaeus included the insects of the group considered here under the vast assemblage to which he gave the ordinal name of Coleoptera. However, they did not long reside under that name. In 1767, Linnaeus transferred them to his order Hemiptera. Then DeGeer, in 1773, established the term Dermaptera for these and certain other insects. Later Fabricius, in 1781, placed them in an order which he called Ulonata. The term Orthoptera did not appear in literature until 1789 when Olivier introduced it in the form "Orthoptères." In more recent times the term Orthoptera has been restricted to the present group, although a strong effort was made to have it also encompass the earwigs, which are now considered to constitute a distinct order, the Dermaptera. The most modern tendency is to divide the Orthoptera into four smaller orders, restricting the term Orthoptera to the jumping forms (such as grasshoppers, katydids, crickets, etc.) and elevating each of the nonjumping families to full ordinal rank with a name based on the technical name of that family, as follows: roaches to be called Blattaria; walking sticks to be called Phasmida; and the mantids to be called Mantodia. This division of the Orthoptera has been gaining in favor with various authors. However, since most standard zoological texts and other works still use the term Orthoptera in its broader sense, the same inclusive implication will be employed here.

The geographic territory that comprises the state of Iowa does not completely encompass the entire range of any species of Orthoptera. All species which are found within its borders actually occupy a more extensive part of the North American continent. Consequently, in any general consideration of the Orthoptera of Iowa a broader approach must be considered. Of all the species of the order known to occur regularly within this state only an exceptional few extend their range south into or beyond Mexico. This, then, established that the largest territory to be considered in preparation of a local study is the North American continent. Such a conclusion is reflected in citing the general known distribution under each species in the text.

The literature pertaining to the Orthoptera of North America is in general fragmentary, scattered and often relatively inaccessible. Except for several checklists of catalogues (such as Scudder's two 1901 works, a "Catalogue" and the "Alphabetical List") the order has never been treated in its entirety in a single work. A number of manuals for recognition of the orthopterous faunae of limited regions have been published. The most ambitious of these was Blatchley's (8) book on the "Orthoptera of North-eastern America." In spite of the limited area implied by the title this work may be more widely applied. Although the nomenclature of the group has been changed in many respects in more recent years, the book is still the most practical starting point for a study of the Orthoptera of the eastern or central United States. The most important of these nomenclatorial changes can be found in a series of state lists which were prepared by Hebard between 1925 and 1945; and several revisionary papers by the Rehns and Hebard separately and in combination. Certain nomenclatorial conclusions given by Roberts in two separate papers (128, 129)

are also pertinent to the problem and will be mentioned at appropriate places in the text.

The categories above generic level adopted for this study are those in common use among orthopterists in this country. No effort has been made to substantiate their validity as that task belongs more properly in the making of a general catalogue, not with the compilation of a synopsis of a local fauna. In the absence of a general catalogue of Orthoptera which gives such information, the authority for each supergeneric name was derived (with few exceptions) from the source indicated among nomenclatorial information given by Handlirsch (45) in Schröder's "Handbuch der Entomologie," the earliest use of the stem, regardless of the ending employed, was adopted as the date of validity for the name. This procedure may be open to question but is consistent with the idea of "priority" as used in lesser categories and is in agreement with proposals by Sabrosky (132). The exceptions to this procedure have been indicated by inserting pertinent comments at appropriate places in the text.

The history of a systematic approach to Iowa orthopterology began in the year 1877 with Bessey's "A Preliminary Catalogue of the Orthoptera of Iowa" in which were listed forty species. This was followed in 1892 by Osborn's paper "On the Orthoptera of Iowa" which indicated Iowa occurrence of eighty-one species. Five years later, in 1897, Ball reported one hundred species, one of them Amblycorypha brachyptera, as new to science, in his "Notes on the Orthopterous Fauna of Iowa." Except for scattered specific Iowa records, these three papers were the main ones dealing with the local fauna until 1935 when Knutson and Jaques gave "A Revised List of the Orthoptera of Iowa" and raised the total number of species for the state to 139. Later papers of a lesser taxonomic scope, but none-the-less important in adding to our knowledge of local representatives of the order, were published by Knutson (85), King and Beams (82), and King (80). All of these papers were devoted to reporting local occurrence of various species; none of them made any attempt to enable local students to recognize the forms with which they might come in contact in the state.

The need for a study which included means of identification and recognition as well as a summary of available information concerning local distribution, season of occurrence and habits has long been felt. The present dissertation is an effort to fill that need. In conformity with the established plans of the Iowa Insect Pest Survey being conducted by the Department of Zoology and Entomology at Iowa State College, this paper is offered as a basic study of an economically important group of insects. The author sincerely hopes that further intensive work by himself and others will allow a more complete version to be built upon this foundation. The present paper includes: 1) keys for identification of all forms known to have been taken within the state plus a few whose general range indicated their probable occurrence; 2) descriptive characterizations which do not repeat the characters used in the key but may be used for more positive identification; 3) notes of two types, the first paragraph following the descriptive matter giving the general range and habitat as indicated in literature, and subsequent paragraphs dealing with data pertinent to the forms as they occur within the state; 4) a tie-in of all previously published Iowa records; and finally 5) a series of illustrations to depict the

normal habitus of the principal forms as well as certain structural details necessary for the identification of specimens. Very little mention is made of the economic importance of the various forms. Instead, interested readers are here referred to the preface of the present paper or to the short, readable summary of "The History of Grasshoppers and Locusts in Iowa" by Drake and Tauber (24) in the forty-sixth Annual Iowa Year Book of Agriculture, pages 177-199. In the latter are discussed various phases of grasshopper damage and control. In nearly all cases where common names have been given, they have been taken from Muesebeck's (95) list of approved common names.

The synonym of many of the Orthoptera is very extensive and involved and would require considerable bibliographic work and taxonomic revision before it could be deemed unravelled. Such work is unwarranted at present due to insufficient time and facilities and because Dr. James A. G. Rehn, leading Orthopterist, is preparing a revision of the Orthoptera of the United States which will undoubtedly include full synonymies. Therefore, in the present study only those synonyms pertinent to this paper and represented by local records will be considered. These synonyms have been listed after the citation of the original description of each species and include the name of the author and the reference for each such usage.

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During the summer months of 1950 and 1951, the author was employed

on the nursery inspection crew of the State Entomologist. Official duties extended into many parts of the state and made possible many off-duty hours of collecting in regions which otherwise would not have been available to the author. For this helpful arrangement sincere thanks are due Dr. H. M. Harris, State Entomologist and Head of the Department of Zoology and Entomology, Iowa State College. In addition, Dr. Harris has been very generous in giving helpful suggestions and criticisms as well as valued opinions on several nomenclatorial questions.

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The fine illustrations are the work of my wife, Elsie Herbold Froeschner.

To all the above-mentioned persons the author is happy to extend his sincerest appreciation and thanks.

ORDER ORTHOPTERA OLIVIER

1789 ORTHOPTERES Olivier, Encycl. Method. Diction. Ins. 4:16, 25.

Mouthparts of chewing type; wings, when present, four in number, net veined, front or outer pair leathery or parchment-like and usually partly overlapping; hind pair more delicate, membranous, folded fanwise; metamorphosis gradual (paurometabolous), nymphs terrestrial.

Of all the commoner insects the grasshoppers are probably the best known and most easily recognized. Whether one is in the fields, woods, or home garden, he is very likely to see some of these creatures. However, the grasshoppers are not the only members of the order; also found in it are the crickets, katydids, roaches, praying mantids, and walking-sticks.

The members of this order show a great diversification of habits; this often being as great within one family as within the entire order, or one family may be very restricted in habits. In several of the families, the males serenade their prospective mates with a characteristic series of notes or calls. Fulton (32) reported results of a very interesting study of these "songs" of "North Carolina's Singing Orthoptera" with a brief discussion of their variations and a key for recognition of the insect musicians by their songs. A more technical discussion of sounds of insects may be found in Pierce's (103) recent book, "Songs of Insects."

Some species range widely geographically and are subject to varying factors in their environment. In response to these environmental differences certain bodily changes occur. These changes may be simple physiological response to ecological conditions, such as the darkening of individuals of a species in a humid meadow or the paling of them in a dry field. In some species with more extensive ranges these changes are such that they enable one to recognize from which part of the range individuals have come. Such differences appear to have a genetic basis and to show evolutionary significance, but have resulted in populations of individuals whose changes have not yet reached the specific level. If the degree of difference is sufficient to justify it, named subspecies are erected; if insufficient, named subspecies are not warranted. "Sufficiency" in these matters is not easy to define. In some cases the differ-

ences are present but not too evident so that only the experienced observer with large series of specimens can appreciate them. In still other cases, even more evident differences which led earlier authors to name species and subspecies on the basis of small series of specimens are not supported by recent studies and so these names must go into synonymy. This latter situation has been of common occurrence in orthopterology so that modern studies have greatly reduced the number of valid names in the order.

Detailed ecological studies of Orthoptera, though needed, are few in number; but papers by such workers as Cantrall (13) and Tinkham (148) show what can be done in that direction.

At the time of writing, 175 species and 7 subspecies were definitely known to occur within the state. Literature records indicated that an addition of six species and one subspecies should also be found. Iowa's Orthoptera fauna is thus seen to contain 182 species and races plus 7 "probable" forms. The total of 189 species and races compared favorably with corresponding figures of more modern state lists. These figures from other states in the central United States showed Indiana with 156 (Blatchley (8)), Illinois with 193 (Hebard (59)), Minnesota with 129 (Hebard (57)), North Dakota with 125 (Hebard (63)), South Dakota with 156 (Hebard (51, 63)) and Kansas with 185 (Hebard (55)). A further comparison made with faunal lists from other parts of the continent showed, in addition, the general northward decrease in numbers of orthopterous forms: Florida 213 (Blatchley (8)), Arizona 282 (Ball et al. (3)), North Carolina 225 (Brimley (10)), Colorado 195 (Hebard (54)), New York 136 (Davis (20)), and Alberta 82 (Hebard (56)). Besides the above permanent members of the local fauna four adventive species have appeared in the state but have not become established. Intensive collecting in several parts of the state, such as the bog areas in the northeast and the counties along the Mississippi River, may yield several species not considered here.

Scudder's (137) "Guide" is the last study to present a key to all of the North American genera known at any one time. Because of its age, that key is very much out of date.

Key to the Families of Orthoptera of Iowa

1. Hind femora more swollen than middle femora, i. e., hind legs fitted for jumping (Figs. 9-28) 4
 - Hind femora not more swollen than middle femora, i. e., hind legs not fitted for jumping (Figs. 1-8) 2
2. Front legs thickened and armed with stout sharp spines, i. e., fitted for grasping (Figs. 7, 8) MANTIDAE p. 185
 - Front legs not noticeably different from other two pairs, neither thickened nor with long sharp spines (Figs. 1-6) 3
3. Body elongate oval, flattened; pronotum expanded laterally and nearly or quite covering head from above (Figs. 1-5). BLATTIDAE p. 171
 - Body elongate, stick-like; pronotum cylindrical, not hiding head from above (Fig. 6) PHASMIDAE p. 189
4. Front legs similar to middle legs, both pairs cylindrical and simple 5
 - Front legs, and sometimes middle legs, strongly flattened, front pair much shorter or of a shape different from middle pair 9

5. Antennae shorter than length of body 6
 Antennae longer than length of body 7
6. Pronotum prolonged posteriorly to or surpassing apex of abdomen;
 front and middle tarsi 2-segmented (Figs. 9,10).
 TETRIGIDAE p. 193
 Pronotum not greatly prolonged posteriorly, not surpassing base
 of abdomen; front and middle tarsi 3-segmented (Figs. 11-14)
 ACRIDIDAE p. 201
7. Tarsi with four distinct segments; tegmina, when present, sloping
 at sides of body with only a small horizontal dorsal area . . . 8
 Tarsi 3-segmented; tegmina, when present, in great part horizontal
 with only a very narrow part turned down . . . GRILLIDAE p. 310
8. Front tibiae with slit-like auditory opening on sides near base
 (Figs. 79,80). TETTIGONIIDAE p. 273
 Front tibiae without auditory opening GRILLACRIDIDAE p. 298
9. All tarsi 3-segmented; antennae with very many fine segments
 GRILLOTALPIDAE p. 326
 Front and middle tarsi 2-segmented, hind ones 1-segmented or
 absent; antennae with not more than 12 elongate segments .
 TRIDACTYLIDAE p. 327

Family BLATTIDAE Latreille

1810 BLATTARIAE Latreille, Considerations Generales, p. 244.

Head horizontal, mouthparts directed posteriorly between bases of first pair of legs; antennae filiform (rarely swollen and plumose at base) and composed of a great number of very short segments, often longer than body; eyes large, finely faceted; ocelli usually present in fully winged individuals, atrophied or absent in apterous or brachypterous ones; tegmina present or absent, in former case variously developed from minute pads to functional organs surpassing apex of abdomen, texture membranous, horny or leathery, inner margins overlapping when fully developed; wings likewise present or absent, texture membranous; abdomen usually strongly flattened, apex bearing a pair of segmented cerci; in males some of the tergites may be variously modified and subgenital plate usually bears a pair of small, unsegmented appendages at apex between segmented cerci.

In most species the eggs are placed in two longitudinal rows in a leathery egg-case or oötheca. This oötheca is carried protruding from the tip of the abdomen of the female until a place suitable for deposition is found. In due time the young hatch. Exceptions to this appear in the roaches, *Panchlora cubensis* Saussure, and *Pycnoscelus surinamensis* (Linnaeus). The former, as reported by Riley (127) and confirmed by later workers, including Davis (21), gives birth to living young. The latter is parthenogenetic wherever it occurs outside of its original habitat in the Orient; in the Orient males as well as females are known (Rehn, 112).

Very interesting biological and habitat notes on several species of cockroaches living in the United States were given by Gould and Deay (37), Rau (104, 105, 106), and Roth and Willis (131).

This family reaches its greatest development, both in size and numbers, in the tropical regions of the world. In the United States, according to Hebard (48), there are about 33 native species and 10 more which

have become established after being introduced from other parts of the world through commerce. The original "homes" of these introduced forms as given in earlier literature was refuted by J.A.G. Rehn (112) who presented evidence that the household pests in the genera Blatta, Blatella, and Periplaneta originated in northern Africa, while those of Pycnoscelus probably started in the Orient.

The records of local specimens show six native species, six established introduced species and three species which have been introduced by commerce but which have not become established as permanent members of Iowa's fauna. The six native forms are all woods-dwellers and seldom, if ever, bother householders. Occasionally specimens are carried indoors on firewood or winged males will be attracted to lights in buildings, but these rarely take up long time residence in homes.

The principal studies dealing with various taxonomic categories of North American members of this family are as follows: for species see Hebard (48); for genera, J.W.H. Rehn (125); and for subfamilies, J.W. H. Rehn (126).

The nine genera that have been found within the state belong to four subfamilies which are separable by the following key:

Key to the Subfamilies of BLATTIDAE in Iowa

1. Middle and hind femora armed below for the greater part of their lengths with two rows of distinct spines 2
Middle and hind femora without rows of spines. EPILAMPRINAE p. 182
2. Pronotum and tegmina glabrous or with very sparse vestiture . . . 3
Pronotum and tegmina densely clothed with fine, minute pubescence; size very large, length 27 mm. or more . NYCTIBORINAE p. 184
3. Size small, pronotum less than 7 mm. long. PSEUDOMOPINAE p. 172
Size larger, pronotum 7 mm. or longer . . . BLATTINAE p. 179

Subfamily PSEUDOMOPINAE Burr

1913 PSEUDOMOPINAE Burr, Coll. Zool. Selys Longchamps, p. 8.

Surface glabrous; tegmina delicate, normal in males, variable in size and development in females; females without valves on seventh abdominal sternite; tarsal claws simple, arolia present.

Both of our native genera as well as two established adventives belong here.

Key to the Genera of PSEUDOMOPINAE in Iowa

1. Front femur with lower front row of spines abruptly decreasing in size near middle of row (Fig. 29) 2
Front femur with lower front row of spines gradually decreasing in length towards apex of femur (Fig. 30) 3
2. Pronotum uniformly black, female with tegmina touching or slightly overlapping; male subgenital plate asymmetrical, right style situated medially at its apex . . . Ischnoptera p. 173
Pronotum not uniformly black except in certain females in which the tegmina are distinctly separated; male subgenital plate symmetrical, style equidistant from median apex . Parcoblatta p. 173

3. Pronotum pale with a longitudinal black stripe either side of
 mid-line Blattella p. 178
 Pronotum without black stripes on disk, side margins usually
 paler Supella p. 179

Genus Ischnoptera Burmeister

1838 Ischnoptera Burmeister, Handb. Ent. 2:500.

Head elongate, ocelli distinct; pronotum feebly convex, in male with two posteriorly converging impressions; tegmina and wings dimorphic, greatly surpassing apex of abdomen in males, not reaching middle of abdomen in females; seventh tergite of males with a narrow, elevated ridge between toothed projections of sixth segment; subgenital plate of male asymmetrical, unsegmented styles both to left of mid-line, right one stouter and bent inward.

Genotype: Ischnoptera morio Burmeister.

The single North American species of the genus occurs in Iowa. It has habits very similar to those given under the genus Parcoblatta.

Ischnoptera deropeltiformis (Brunner)

1865 Temnopteryx deropeltiformis Brunner, Nouv. Syst. Blatt. p. 87.

Males dark brown to black, shining pronotum strongly deflexed laterally, broadly rounded behind; tegmina paler, translucent; legs tannish-brown. Females shining black, mouthparts and legs reddish-brown; tegmina quadrate, not reaching middle of abdomen, overlapping along inner margins, apex obliquely emarginate on inner half or more. Length of body, 11.4-17.8 mm.

The range of this roach extends from New Jersey to Florida and west to Iowa, Kansas, and Texas. It is most often found under debris on the floor of woods.

In Iowa this appears to be an early summer form, available records of adults extending from June 12 until July 2. It was reported for the state by Hebard (48).

Cedar, Henry, Jackson, Johnson, Lee, Linn, and Muscatine counties.

Genus Parcoblatta Hebard

1917 Parcoblatta Hebard, Mem. Am. Ent. Soc. No. 2, p. 70.

Pronotum feebly convex dorsally, decidedly so laterally, hind angles broadly rounded; tegmina and wings dimorphic, either surpassing apex of abdomen (as in all males) or falling considerably short of apex (as in most females); tarsals I-IV each with a pulvillus beneath; unsegmented styles of males slender, cylindrical, decurved, right one slightly longer.

Genotype: Blatta pensylvanica (!) DeGeer

Members of this genus are all native inhabitants of woods or woods borders; occasionally specimens are carried indoors on firewood or winged males will fly to lights but these seldom take up long time residence in homes. In their haunts they prefer to hide under loose bark on logs and stumps, but can also be found under rocks, leaves, or other litter on the ground. Here they act chiefly as scavengers, eating dead and decaying

plant and animal remains. However, fresh berries and some tender seedlings are also taken as food. With alight variation, the general life cycle finds the adults present during the early and middle summer months. The eggs are laid throughout most of this same period. The newly hatched nymphs feed and attain various ages by the advent of winter weather. Cold weather does not seem to interfere with their running ability for, if disturbed, even in near zero temperatures, they will scurry for a new hiding place. With the return of warmer weather in spring, feeding is resumed, the nymphs mature and transform into adults. Rau (105) and Edmunds (25) have given some interesting observations on several species of this genus.

In this genus, good specific characters are furnished by modifications occurring on certain of the abdominal tergites of the males. Former workers had given special names to these modified tergites as indicated by the following quotation from Blatchley (8): "The first one behind the metanotum above is known as the median dorsal segment, the next as the basal or first dorsal segment." Since these actually are morphologically the first and second abdominal tergites, they are so designated in the present paper.

Seven of the twelve North American species of the genus are represented by Iowa records.

Key to the Species of Parcoblatta in Iowa

1. Subgenital plate with a median pair of small, unsegmented styles in addition to the segmented cerci (Fig. 32); tegmina surpassing apex of abdomen (Fig. 5) . . . (males) 2
 - Subgenital plate without styles; tegmina falling considerably short of apex of abdomen (Fig. 4) . . . (females) 8
2. Size smaller, length of pronotum rarely as great as 4 mm. . . 3
 - Size larger, length of pronotum more than 4 mm.; lateral margins of pronotum and tegmina usually broadly translucent yellow . . 7
3. Cerci with inner apical angles of segments VI-XI acutely though briefly produced (Fig. 31); first abdominal tergite with a pair of raised ridges, each with a heavy tuft of hair. P. uhleriana p. 175
 - Cerci not so produced on inner apical angles of segments VI-XI 4
4. Head and at least part of pronotal disk dark brown or black; first and second abdominal tergites unmodified . . . P. bolliana p. 175
 - Head and pronotum not blackened; first abdominal tergite with scattered hairs or otherwise modified 5
5. First abdominal tergite with numerous scattered hairs medially P. virginica p. 176
 - First abdominal tergite with a pair of raised ridges, each bearing a heavy tuft of hairs 6
6. Abdominal tergites I and II both with tufts of hairs. P. caudelli p. 177
 - Abdominal tergite I only with tufts of hair . . . P. fulvescens p. 176
7. Disk of pronotum dark chocolate brown or darker; abdominal tergites I and II each with a pair of overhanging elevations which are heavily haired below at apex P. pennsylvanica p. 177
 - Disk of pronotum and tegmina pale reddish-brown to tan; abdominal tergites I and II each with a pair of feeble elevations supplied with a tuft of hairs P. lata p. 176

8. Tegmina distinctly separated 9
Tegmina touching or overlapping along inner margins 10
9. Tegmina separated by a space nearly twice the width of
one of them P. bolliana p. 175
Tegmina separated by a space which is less than the width
of one of them P. uhleriana p. 175
10. Tegmina not more than 3.5 mm. long, apices truncated,
usually slightly emarginate near sutural angle 11
Tegmina more than 4 mm. in length 12
11. Abdomen polished black; pronotum and tegmina with broad
lateral margins abruptly pale, contrasting with darker brown
disks P. caudelli p. 177
Abdomen brown; pale lateral margins of pronotum and tegmina
fading into somewhat darker disks P. virginica p. 176
12. Both pronotum and tegmina dark brown to piceous discally
with lateral margins abruptly and contrastingly paler; apices
of tegmina not truncated P. pennsylvanica p. 177
Pronotum and tegmina tan to brown, lateral margins not sharply
contrasting; apices of tegmina conspicuously truncated 13
13. Tegmina obliquely truncated apically, outer angles sub-
rectangular P. fulvescens p. 176
Tegmina obliquely truncated apically, outer angles rounded,
hind margins sometimes sinuated near inner margin P. lata p. 176

Parcoblatta bolliana (Saussure and Zehntner)

1893 Ischnoptera bolliana Saussure and Zehntner, Biol. Centr.-Amer.,
Orthop. 1:4.

Male pale brownish-yellow, side margins of pronotum and tegmina paler; dark markings of pronotum may form two vague, discal stripes. Female blackish-brown, legs paler; tegmina very small oblong pads, outer margin straight, recurved, inner margin rounding obliquely into apex. Length of body, 9-12.8 mm.

This scarce roach is known to range from North Carolina and Georgia west to Nebraska and south to the Mexican border. It is a woods-dwelling form; the winged males sometimes coming to lights.

Literature records given by Hebard (48, 55) furnish the only definite data concerning the Iowa occurrence of this species. The two counties indicated by him are listed below.

Johnson and Lee counties.

Parcoblatta uhleriana (Saussure)

1862 Ischnoptera uhleriana Saussure, Rev. et Mag. Zool. 2e ser. 14:169.

Males pale brownish-yellow, tegmina often somewhat darker. Females blackish-brown, legs and costal margin of tegmina slightly lighter; tegmina triangular, not surpassing base of second tergite. Length of body 9.8-16.5 mm.

This roach ranges from Massachusetts to Michigan and Iowa and south to Florida and Mississippi. It is a forest-loving species which seeks shelter beneath loose bark or debris on the woods floor.

Local occurrence of this species was given by Hebard (48), Blatchley (8), and Hebard (55). Although uncommon in local collections, available records indicate the adult season to extend from April 25 to July 2.

Cedar, Henry, Johnson, and Story counties.

Parcoblatta virginica (Brunner)

1865 Temnopteryx virginica Brunner, *Nouv. Syst. Blatt.* p. 86.

1876 Ischnoptera unicolor Thomas, *Proc. Davenport Acad. Nat. Sci.* 1:250.

1892 Ischnoptera borealis Osborn, *Proc. Iowa Acad. Sci.* 1(2):117.

1897 Ischnoptera unicolor Ball, *Proc. Iowa Acad. Sci.* 4:235.

Male pale brownish-yellow, sides of pronotum and tegmina slightly paler; underside similarly colored. Female usually chestnut- or reddish-brown with pronotum and tegmina darker. Length of body, 11.5-15.4 mm.

The present insect ranges from Maine to Minnesota, Nebraska, and Kansas and south to North Carolina, Kentucky, and Alabama. It is most frequently encountered along woodland borders.

In Iowa this roach is quite common although local collections do not contain it in any numbers. The males of this are the most common of the Parcoblatta to come to electric lights. Adult records at hand were for the period from May 19 to July 15. It was listed for the state by Hebard (48) and Knutson and Jaques (86).

Cedar, Clayton, Des Moines, Dickinson, Dubuque, Fremont, Henry, Johnson, Lee, Linn, Louisa, Marion, Monroe, Muscatine, Palo Alto, Polk, Story, Wapello, Warren, Washington, and Woodbury counties.

Parcoblatta fulvescens (Saussure and Zehntner)

1893 Ischnoptera uhleriana (var) fulvescens Saussure and Zehntner, *Biol. Centr.-Amer., Orthop.* 1:36.

Male brownish, paler along sides of pronotum and tegmina; pronotum widest slightly behind middle. Females reddish-brown, abdomen slightly darker, legs much paler. Length of body, 10.8-16.6 mm.

This insect is known to occur from New York west to Iowa and south to Florida, Arkansas, and Texas. It frequents woods just as do other members of the genus.

The only data available for the Iowa occurrence of this species was Hebard's (48) record for Dallas County on July 21; it served as the basis for subsequent listings by Blatchley (8) and Hebard (55). No Iowa specimens were seen during this study.

Parcoblatta lata (Brunner)

1865 Temnopteryx lata Brunner, *Nouv. Syst. Blatt.* p. 135.

General color pale reddish-brown, margins of pronotum and tegmina and legs yellowish; pronotum widest at middle; tegmina of female reaching apex of second tergite. Length of body, 15-22 mm.

The general range of this roach is in the southeastern United States from Delaware to Florida and west to Missouri and Texas.

Although Iowa is well removed from the general area commonly attributed to this species, the form is included here on basis of data furnished

by J.A.G. Rehn (MS.) from a single male in the collection of the Academy of Natural Sciences of Philadelphia. It bore the label, "Page County, Iowa, June 2, 1934 (Bagnall)."

Parcoblatta pennsylvanica (DeGeer)

1773 Blatta pennsylvanica (!) DeGeer, Mem. l'Hist. Nat. Ins. 3:537.

1876 Ischnoptera pennsylvanica Thomas, Proc. Davenport Acad. Nat. Sci. 1:249.

1892 Platamodes pennsylvanica Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Ischnoptera pennsylvanica Ball, Proc. Iowa Acad. Sci. 4:235.

Color chestnut-brown to fuscous with sides of head, lateral and sometimes anterior margin of pronotum, and submarginal stripe near base of costal margin of tegmina usually broadly yellow; legs yellowish. Length of body, 12.7-24.5 mm. (Figs. 4, 5).

This insect ranges across southern Canada as far west as Ontario and then south in the United States to Georgia and Texas and west to Nebraska and Kansas.

The Pennsylvania woodroach is the commonest native roach in Iowa. Adults have been found during the period from April 14 to August 7. Rau (105) studied in considerable detail the life history of this species in Missouri and included some observations on the courtship activities. His caged females produced as many as eleven egg-cases between June 23 and September 24; each case yielded between eighteen and thirty nymphs about one month later. Two wasps are known to prey on this species; the thread-waist wasp, Podium carolina Rohwer, uses it as food for its young when provisioning the nest; the Hyptia thoracica (Blanchard) parasitizes the eggs in the oötheca. Iowa records were given by Hebard (48), and Knutson and Jaques (86).

Allamakee, Appanoose, Boone, Cedar, Cerro Gordo, Clayton, Crawford, Dallas, Davis, Delaware, Des Moines, Dickinson, Emmet, Fremont, Hancock, Henry, Iowa, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Lyon, Marion, Monona, Monroe, Muscatine, Polk, Sioux, Story, Van Buren, Wapello, Warren, Washington, and Winneshiek counties.

Parcoblatta caudelli Hebard

1917 Parcoblatta caudelli Hebard, Mem. Am. Ent. Soc. No. 2, p. 122.

Color pale yellow with occiput, bar across middle of face, disk of pronotum and tegmina brownish; pronotum widest slightly behind the middle; tegmina of male distinctly surpassing apex of abdomen, of female dimorphic in development, either slightly surpassing tip of abdomen or (as in available specimens) not reaching middle of abdomen. Length of body, 10.7-16 mm.

The general distribution of this species has been given in literature as extending from Virginia and Washington, D.C. west and south to southern Indiana, Arkansas, and Texas. Its habits appear to be similar to those of other members of the genus.

Although Iowa has not been included within the general range of P. caudelli, this species has been incorporated in the present study on the basis of five state specimens; four of which were determined by Hebard.

The data found on the labels is copied below:

Johnson Co., 1 male, July 10, 1935 (R.L. King)(King colln);

1 female, June 26, 1935 (King colln.); Muscatine Co.

Male, female, July 6, 1935 (R.L. King)(King colln.); Boone Co.

1 female, July 18, 1950 (R.C. Froeschner)(Froeschner colln).

Although the allotypic and paratype females were described as being long-winged in contrast to the usual brachypterous condition found in females of this genus, the three Iowa females studied were short-winged. In reply to a query concerning the short-winged condition found in these females, J. A. G. Rehn (MS.) replied, ". . . that is, on the basis of Hebard's determination of material here, the usual condition of that sex." He further commented that the long-winged allotype was still in the collection of the Academy of Natural Sciences of Philadelphia, but that the more than fifty female specimens collected by Hebard since the original description of the species all were short-winged.

Genus Blattella Caudell

1903 Blattella Caudell, Proc. Ent. Soc. Washington 5:234.

Head long, almost hidden by small, suborbicular pronotum; eyes well separated, ocellar spots distinct; tegmina and wings reaching or surpassing apex of abdomen; tarsal segments elongate, arolia very small.

Genotype: Blatta germanica Linnaeus.

The single species of the genus which occurs in Iowa is a cosmopolitan pest and has long been established in the state.

Blattella germanica (Linnaeus)

1767 Blatta germanica Linnaeus, Syst. Nat. Edit. XII, 1:668.

1892 Ectobia germanica Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Ectobia germanica Ball, Proc. Iowa Acad. Sci. 4:235.

Yellowish-brown, females often slightly darker than males; pronotum bivittate as in key; legs paler than body. Length of body, 10.5-12.4 mm.

An introduced domiciliary pest, the "German cockroach" is one of the most abundant and omnipresent of household nuisances, being found in buildings throughout the United States and parts of Canada. According to evidence presented by Rehn (112), the original "home" of this cockroach was in northern Africa, not Europe as suggested by the trivial name. In the colder climate of Iowa and other northern regions it cannot winter out-of-doors, but does remarkably well in heated buildings. The light brown, slightly flattened oötheca contains some thirty-six eggs placed in two rows. The female often runs about for several days with this egg case protruding from the tip of her body before dropping it in a suitable place. For this roach, food consists chiefly of starch materials like bread and the paste used on so many household articles. However, if hungry, it will eat a great variety of substances.

In spite of the abundance of this species in homes and public buildings within the state, comparatively few specimens were to be found in local collections. Seasonal data on specimen labels indicated that this species will occur in immature or adult stages throughout the year here as elsewhere. Knutson and Jaques (86) also listed it for the state.

Boone, Crawford, Dallas, Des Moines, Fremont, Greene, Hardin, Henry, Jefferson, Johnson, Keokuk, Lee, Louisa, Monroe, Polk, Pottawattamie, Story, Van Buren, Washington, and Woodbury counties.

Genus Supella Shelford

1911 Supella Shelford, Ent. Month. Mag. Ser. 2, 22:155.

Eyes well separated, interocular area flat, raised to form a rounded angulation with ocellar area; tegmina narrow, delicate, with nine to eleven strong, oblique radial sectors; front femora with two longer, unequal spines at apex; tarsal I longer than II-V together.

Genotype: Blatta supellectilium Serville.

The single North American species is an introduced tropical species.

Supella supellectilium (Serville)

1839 Blatta supellectilium Serville, Hist. Nat. Ins. Orthop. p. 114.

Clay-yellow to reddish-brown, face darker; pronotal disc reddish-brown, fading off into translucent yellow sides; tegmina variably colored, usually with a pale crossband on basal third; legs and under surface paler; pronotum narrowed from basal third to apex, all angles rounded, disk slightly convex. Length of body, 11.2-11.7 mm.

The "brown-banded roach" which J.A.G. Rehn (112) said originated in northern Africa, has been introduced into the United States where in recent years its range has been spreading widely. Back (1) and Rehn (109a) have given habit and distribution notes for the species on this continent. It was first reported from Florida in 1903 and has since been found as far north as Pennsylvania, Indiana, Illinois, Missouri, and Nebraska, and west to California and Arizona. In the more northern parts of the country it appears unable to thrive except in warmed buildings.

At Ames this roach is not uncommonly included in student collections indicating that it is fairly common in the city. More intensive collecting has found the species to be present in groceries, bakeries, and other types of stores as well as in homes and public buildings. In some homes it has been found in sufficient numbers to justify control measures. It has the disconcerting habit of wandering into any part of a home, not restricting its activities to the kitchen as do the other domestic species.

All available records were from Ames in Story County and had been collected as adults between April 20 and July 29, and as nymphs from May 25 to June 21. Although the earliest year represented in local collections is 1947, the widespread abundance of the species as determined in 1949 and 1950 indicated a much longer period of occurrence in Ames.

Subfamily BLATTINAE Latreille

1810 BLATTARIAE Latreille, Considérations Générales, p. 244.

Vertex usually exposed; ocellar spots usually present; tegmina, when present, semicoriaceous; styli of males slender, of equal length, and set in sockets on apical margin of subgenital plate; subgenital plate of female valvular at middle apex, valves limited basally by a transverse suture; femora with ventral margins heavily spined.

Both of Iowa's genera that belong to this subfamily were said by Rehn (112) to have originated in northern Africa.

Key to the Genera of BLATTINAE in Iowa

1. Tegmina not reaching apex of abdomen Blatta p. 180
- Tegmina greatly surpassing apex of abdomen . . . Periplaneta p. 181

Genus Blatta Linnaeus

1758 Blatta Linnaeus, Syst. Nat., Edit. X, 1:424.

Robust species with antennae elongate, setaceous; interocular space in male slightly wider than that between bases of antennae; tarsal segment I longer than others united; tarsals I-IV each with a small pulvillus; arolia absent or minute, never reaching middle of claws.

Genotype: Blatta orientalis Linnaeus.

The single species known to occur in North America is the notorious "oriental cockroach" which is too common in Iowa.

Blatta orientalis Linnaeus

1758 Blatta orientalis Linnaeus, Syst. Nat. Edit. X, 1:424.

1876 Periplaneta orientalis Thomas, Proc. Davenport Acad. Nat. Sci. 1:250.

1892 Periplaneta orientalis Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Periplaneta orientalis Ball, Proc. Iowa Acad. Sci. 4:235.

Male shining dark chestnut brown, pronotum and tegmina often slightly lighter; tegmina and wings about equally developed, covering about three-fourths of abdomen and usually at least touching along inner margins. Females usually nearly uniformly shining blackish-brown, legs slightly paler; tegmina represented by mere pads that are widely separated and scarcely attain base of first abdominal segment. Length of body, 18-24 mm. (Figs. 1, 2).

The original habitat of the "oriental cockroach" has long been stated in texts to be in Asia, but Rehn (112) presented evidence which indicated northern Africa to be its area of origin. It is probably one of the most omnipresent and objectionable of all household pests. However, it seems to be restricted more to the cities. Here it thrives in filth and darkness; and in its night-time prowling for any of the many types of products on which it is known to feed it actually damages more than it consumes. Rau (107) gave results of some "food preference" experiments with this cockroach which indicated "that starch foods are practically the entire choice of oriental cockroaches." The "roachy" odor which it leaves behind in its droppings and body secretions renders food and other items unfit for use. Its carnivorous habits are said by some to take a special liking for the "bed bug", which it is supposed to quickly eradicate from a dwelling. However, this is an instance where the cure is as bad as the ailment and so is not recommended. Rau's (107) studies on the biology of this species showed that it has a one year life cycle and that adults are present from May through August; nymphs are present and, in sufficiently warm places, active throughout the year.

Local specimen-records do not agree with this seasonal distribution. Adult specimens were available for every month of the year. This species was listed for the state by Bessey (6) and Knutson and Jaques (86).

Appanoose, Boone, Des Moines, Fremont, Henry, Jefferson, Johnson, Lee, Louisa, Polk, Story, Van Buren, and Washington counties.

Genus Periplaneta Burmeister

1838 Periplaneta Burmeister, Handb. Ent. 2:502.

Antennae much longer than body; head with interocular space less than that between bases of antennal sockets; pronotum convex, sides deflexed; tegmina leathery, costal margins arcuate; first segment of hind tarsi longer than the others united, arolia very small.

Genotype: Blatta americana Linnaeus.

Of the four North American species in this genus three are represented by local specimens.

Key to the Species of Periplaneta in Iowa

1. Color not uniformly blackish-brown 2
Color uniformly blackish-brown P. fuliginosa p. 182
2. Tegmina without a pale subcostal stripe near base; pronotum with markings brownish, vaguely delimited . . . P. americana p. 181
Tegmina with a conspicuous yellow, subcostal stripe along basal third; pronotum with hind margin and bilobed discal spot with sharply defined shining black P. australasiae p. 182

Periplaneta americana (Linnaeus)

1758 Blatta americana Linnaeus, Syst. Nat. Edit. X, 1:424.

Color reddish-brown, pronotum yellow with two large, usually contiguous, suffused brown spots on apical half of disk and posterior margin reddish-brown; legs and under surface brownish-yellow; tegmina and wings much surpassing apex of abdomen in both sexes. Length of body, 27.8-34.2 mm.

The "American cockroach" is a fairly common, introduced, domiciliary pest that, according to Rehn (112), originally came, with other species of the genus, from northern Africa rather than the American tropics as has long been supposed. It is known to occur on the North American continent from New York to Minnesota south to the Gulf coast and westward through New Mexico into California. In the southern part of this range it lives out-of-doors, while farther north it can maintain residence only by establishing itself in heated buildings. Like the German roach, it is less of a lover of filth and so frequents the drier, cleaner part of buildings. Its appetite is as general as that of the other two common household roaches and includes most starchy foodstuffs as well as paste, vegetables, and even growing plants. Because of this latter taste it often does considerable damage in greenhouses. Under normal indoor conditions, a year is required for a complete life cycle, but lack of food or other adversities may extend that period considerably. Rau (106) has published a life history study of this species.

Although available Iowa records are not many, the species probably does occur in larger towns and cities throughout the state. Ball (2) and Knutson and Jaques (86) both included it in their local lists.

Boone, Des Moines, Henry, Lee, Monroe, Polk, Story, Wapello, and Woodbury counties.

Periplaneta australasiae (Fabricius)

1775 Blatta australasiae Fabricius, Syst. Ent. p. 271.

Tegmina reddish-brown, darker exterior to subcostal pale stripe; under surface and legs pale reddish-brown; tegmina less than twice as long as their combined width. Length of body, 23-29 mm.

The "Australian cockroach" is reported as being established on this continent only in Florida and occurring elsewhere in the United States as an adventive. In the latter role it is frequently brought into more northern cities on shipments of fruit.

The single specimen collected in Sioux City, Woodbury County, by C.N. Ainslie undoubtedly represents just such an introduction.

Periplaneta fuliginosa (Serville)

1839 Kakerlac fuliginosa Serville, Hist. Nat. Ins. Orthop. p. 70.

Dorsum uniformly shining brownish-black, tegmina and legs often tinged with reddish-brown. Length of body, 24-32.5 mm.

This species is established in the southern United States where it is known to occur out-of-doors from Florida west to Texas.

The small colony which is established in the greenhouses on Iowa State College campus in Ames, Story County, has been there at least since 1923 as is shown by labels on specimens in the college collection. At the time of writing of this study these insects caused considerable concern to those who make use of the greenhouses infested by them. All specimens had been collected during April, May, and October. Knutson and Jaques' (86) listing of the species was based on this same colony.

Subfamily EPILAMPRINAE Saussure

1864 EPILAMPITES Saussure, Mem. 1'Hist. Mexique, 3:73.

Posterior margin of pronotum briefly but broadly produced medially; tegmina and wings usually fully developed; under sides of femora not spined, except at apex, but front ones sometimes with a heavy fringe of hairs; tarsal segments very slender, elongate, with at least moderately large pulvilli; arolia distinct.

Key to the Genera of EPILAMPRINAE in Iowa

- 1. Hind tarsal segments naked beneath; general color brownPycnoscelus p. 183
- Hind tarsal segments haired beneath; general color greenPanchlora p. 183

Genus Pycnoscelus Scudder

1862 Pycnoscelus Scudder, Boston Jour. Nat. Hist. 7:421.

Pronotum convex, sides declivent, hind margin broadly obtuse-angulate; tegmina reaching or surpassing apex of abdomen; lower front margin of front femora with a row of hairs which are longer basally; arolia small.

Genotype: Blatta surinamensis Linnaeus.

The genotype is the only species known to occur on this continent; it has become established indoors in Iowa.

Pycnoscelus surinamensis (Linnaeus)

1767 Blatta surinamensis Linnaeus, Syst. Nat. Edit. X, 1:424.

Head and pronotum mostly shining blackish-brown, latter distinctly punctate and with anterior and frequently lateral margins yellowish-white; tegmina dull brownish-yellow, with basal subcostal pale stripe; underside and legs brownish-yellow with side margins of abdomen darker; tegmina with a row of close-set punctures along either side of veins. Length of body, 16.3-23 mm. (Fig. 3).

The "bicolored cockroach" occurs widely throughout the world; and in all parts where studied, except the Orient, has proven to be parthenogenetic. J.A.G. Rehn (112) has considered this bisexual population of the Orient as a strong clue that Asia was the original habitat for the species. This species has become established in North America where it occurs out-of-doors in the Gulf states from Florida to Texas and indoors farther north. Nymphs of this species may be readily recognized by the presence of irregular, transverse rows of tubercles on most of the dorsal abdominal segments, the tubercles being obsolete on the basal segments and most conspicuous toward apex of abdomen. Besides being a pest in buildings, this cockroach is known to be the "intermediate host and agent for transmission of chicken eye worm (Oxyspirura parvovum)" (Rehn (112)).

It has been present in some of the buildings on the campus of Iowa State College at Ames, Story County, since 1936 and was still present in 1950 and 1952. Compared to our other household roaches, it is a very sluggish insect. Its lack of speed may be accounted for by its very short legs. All adult records were from females and were for the period from April 7 until June 22.

Genus Panchlora Burmeister

1838 Panchlora Burmeister, Handb. Ent. 2:506.

Pronotum convex, sides declivent, hind margin broadly obtuse-angulate; tegmina and wings distinctly surpassing apex of abdomen; tarsal segment I with a large, rounded pulvillus on apical half; arolia large.

Genotype: Panchlora pulchella Burmeister.

A single tropical species has been repeatedly brought onto this continent with shipments of fruits, especially bananas. It apparently is not very adaptable as only a single establishment has been reported from our country.

Panchlora cubensis Saussure

1862 Panchlora cubensis Saussure, Rev. et Mag. Zool. Ser. 2, 14:230.

Pale green, occiput, pronotum and tegmina with a yellow-white submarginal line; tegmina frequently with a small dark spot at apical third; eyes narrowly separated by a space equal to one-eighth of the diameter of one of them; pronotum widest behind the middle where the side margins are subangulate, disk finely and transversely rugose. Length of body, males, 12.2-14 mm; females, 15.7-18 mm.

This beautiful, graceful, "Cuban cockroach" frequently appears in many parts of the country on shipments of bananas and other fruits from the South American tropics. It is known to be established in the United States only near Brownsville, Texas, where conditions are almost tropical.

In addition to the literature record of Knutson and Jaques (86) more than two dozen specimens which had been taken within the state were available for study. Some of these bore notations stating that they had been taken from bananas. Months represented by specimen-data were March, April, May, and November.

Adair, Clarke, Des Moines, Henry, Iowa, Johnson, Keokuk, Muscatine, Page, Poweshiek, and Woodbury counties.

Subfamily NYCTIBORINAE Brunner

1893 NYCTOBORIDAE Brunner, Ann. Mus. Civ. Stor. Nat. Genova 33:11.

Eyes almost touching above; tegmina leathery, reaching at least to apex of abdomen; spines on underside of front femora subequal in length and confined to apical half; tarsal segments I-IV with pulvilli beneath; supra-anal plate triangular, not valvate in female.

Several species of one genus frequently ride into the United States on fruit shipments from the American tropics; however, none of them is known to be established in North America, and only one of them has been taken in Iowa.

Genus Nyctibora Burmeister

1838 Nyctobora Burmeister, Handb. Ent. 2:501.

Tarsi with arolia between claws.

Genotype: Nyctobora sericea Burmeister.

Only one of the several adventive species of this genus has been collected in Iowa.

Nyctibora noctivaga Rehn

1902 Nyctobora noctivaga Rehn, Trans. Am. Ent. Soc. 29:3.

Dark brown without paler marking dorsally but thickly clothed above with numerous minute, prostrate yellow hairs; pronotum widest near base, hind margin broadly rounded. Length of body, 30-37 mm.

A large, conspicuous native of the South American tropics, this roach is often carried into the United States hidden away in stalks of bananas.

In the collection of the Iowa State College is a single specimen taken in Ames, Story County, on May 5, 1902. In literature Hebard (48) reported a nymph from Iowa City, Johnson County; and Knutson and Jaques (86) listed it for the state.

Family MANTIDAE¹ Latreille

1810 MANTIDES Latreille, *Considérations Générales*, p. 245.

Head triangular, attached by a narrow neck and freely movable; prominent compound eyes and usually three ocelli present; antennae long, slender, usually filiform or setaceous; prothorax elongate with front legs inserted beyond middle; tegmina and wings usually present in both sexes, sometimes shorter than abdomen or absent; abdomen of female broader than in male, without an ovipositor, tipped in both sexes by a pair of segmented cerci; front legs fitted for grasping, i. e., stout, coxae elongated, tibia spined ventrally and capable of being folded against the spined ventral margins of the femur; middle and hind legs slender, adapted for walking.

The many popular names that have been given to these insects attest to their attention-arresting appearance. These names include "praying mantid," "soothsayers," "mule killer," "devil's horse" and "rear horse". The general fear of these insects which is evidenced by some of these names is unfounded. The mantids are perfectly harmless to man and larger animals. They possess no poison apparatus and harm only other insects which serve as food. An exception appears in the tropics where certain of the larger mantids have been reported as catching and eating small birds. At least in some species the females will eat the head and forward parts of the male during mating, even while their bodies are locked in copulation. Because of their strictly carnivorous habits, the mantids must capture and subdue their prospective food. The prey is stalked very cautiously until it is within reaching distance when the front legs unfold and flash out to grab the victim. The numerous eggs are inclosed in an egg-case or oötheca which is glued to rocks, twigs or other support in late summer and early fall. The young emerge the following spring and begin maturing by midsummer. More extensive habit notes on the mantids may be found in Gurney's (42) semipopular treatment of the family as it occurs in the United States.

This is distinctly a group of the warmer climates, only three of the twelve genera known from the United States ranging as far north as Iowa. Efforts were made during the 1930's to introduce another form, apparently without success.

The important studies on this group for North America were by Caudell (17) and Hebard (67); and for the world by Giglio-Tos (36) and Beier (4, 5).

Key to the Subfamilies of MANTEIDAE in Iowa

1. Front coxa not dilated at apex of upper front margin; front tibiae at least half as long as front femora MANTEINAE p. 186
- Front coxae with plate-like dilation at apex of upper front margin (Fig. 34); front tibiae not more than one-third as long as front femora. THESPINAE p. 188

¹Roberts (128) presented evidence that the proper form for this name is MANTEIDAE; but since most authors, including Gurney of the National Museum in a paper as late as 1951, have used the shorter version, that spelling is being retained here.

Subfamily MANTEINAE Latreille

1810 MANTIDES Latreille, *Considérations Générales*, p. 245.

Head usually wider than long; eyes very large, prominent; ocelli normally developed only in males; front tibiae never spined above; tegmina and wings in male rarely, and in females frequently, reduced or absent; cerci occasionally elongated or flattened.

There are local records for three of the nine genera which range north of Mexico.

Key to the Genera of MANTEINAE in Iowa

1. Hind femora with spine at outer apex; pronotum in length subequal to front coxae; smaller species, length not over 37 mm. *Litaneutria* p. 186
- Hind femora without spine at apex; pronotum much longer than front coxae; larger species, length over 45 mm. 2
2. Facial shield (sclerite between antennae and clypeus) transverse, more than twice as wide as high (Fig. 33); hind tarsi with segment I not longer than next three together . . . *Stagmomantis* p. 187
- Facial shield less than twice as wide as high; hind tarsus with segment I at least as long as all following segments combined *Tenodera* p. 187

Genus Litaneutria Saussure

1892 Litaneutria Saussure, *Soc. Ent.* 7:123.

Facial shield transverse; vertex at most slightly convex; eyes rounded or obtusely conical; pronotum widened above coxal insertions; tegmina and wings fully developed or brachypterous, former subhyaline; hind tarsi with segment I almost as long as all following segments combined.

Genotype: Litaneutria ocularis Saussure.

One species of this genus occurs in the United States where it ranges from the Mexican border north to British Columbia, North Dakota, and Iowa.

Litaneutria minor (Scudder)

1872 Stagmatoptera minor Scudder, *Rep. U. S. Geol. Surv. Neb.*, Final Report, pt. III, p. 251.

Gray to brown, variously mottled with fuscous; tegmina and wings may be long (reaching almost to apex of abdomen) or short (reaching apex of second abdominal segment). Length of body, 26–31 mm. (Fig. 7).

This mantid ranges from the Pacific Coast east to western Iowa and Missouri and north from Mexico and Texas to British Columbia. It is chiefly an inhabitant of dry prairies or areas simulating them.

In Iowa both adults and nymphs of this insect may be found most commonly on the ground among the sparse vegetation on the loess bluffs in the westernmost tier of counties. The only record available for any other occurrence within the state is a series of specimens collected in the eastern third in Johnson County by King. Hendrickson (71), in his prairie

studies in the state, found nymphs in an Andropogon scoparius-Bouteloua curtipindula association. Literature records for the state were given by Hendrickson (loc. cit.), Knutson and Jaques (86), and Hebard (67). Local data on nymphs showed them to be present during June and July; those on adults indicated their season to extend from July 23 until October 3. All these imagoes were of the short-winged form.

Johnson, Plymouth, Sioux, and Woodbury counties.

Genus Stagmomantis Saussure

1869 Stagmomantis Saussure, Mittheil. der Schweiz. Ent. Gesells. 3:56.

Vertex transverse, but slightly elevated; antennae inserted above middle of eyes; pronotum dilated at apical third with lateral margins carinate; tegmina of females opaque and usually with a distinct median, subcostal black spot; in males somewhat transparent and with black spots often indistinct or absent; females much stouter than males.

Genotype: Gryllus carolinus Johannson.

Of the five species listed for the United States by Gurney (42), but one occurs in Iowa.

Stagmomantis carolina (Johannson)

1763 Gryllus carolinus Johannson, Amoen. Acad. 6:396.

Male slender, color grayish, mottled with brown; body and legs often in part green; tegmina surpassing apex of abdomen, somewhat translucent; hind wings hyaline or slightly washed with pink. Female robust, occurs in two color forms; either all green or gray mottled with brown as in male, a conspicuous black spot on tegmina at middle near costal border; tegmina opaque, short, reaching to apical third of abdomen, costal area tapering from base. Length of body, 48-57 mm.

The "Carolina mantid" occurs in the United States as far north as New Jersey, Ohio, Iowa, and Nebraska, and from the east coast west to Colorado and Texas. This insect frequents weeds and low shrubs where it is made rather inconspicuous by its blending colors.

The more than twenty Iowa specimens studied indicated that this mantid occurs only in the southern half of the state and most commonly in the southeastern part. Adult records covered the period from September 18 to October 25. One of these adults, a female in the Iowa Insect Survey collection, is strongly washed with pink on the body and appendages, the hind wings being almost testaceous; it reminds one of the "pink forms" that have often been reported for certain green tettigoniids and fulgoroids. The species was listed for the state by Knutson and Jaques (86).

Keokuk, Lee, Madison, Shelby, and Washington counties.

Genus Tenodera Burmeister

1838 Tenodera Burmeister, Handb. Ent. 2:534.

Eyes oval; pronotum with feebly widened part not less than one-fourth from apex, side margins of female finely but thickly serrate; tegmina and wings fully developed in both sexes, tegmina lacking black spot found in our species of Stagmomantis; middle and hind tibiae with apical spines;

first segment of hind tarsus at least as long as the remaining segments together.

Genotype: Mantis aridifolia Stoll.

Two species of this Asiatic genus have been imported into the United States. Some efforts were made to add one of them to Iowa's fauna, apparently without success.

Tenodera aridifolia sinensis Saussure

1871 Tenodera aridifolia variety sinensis Saussure, Mem. Soc. Geneve, 21:295.

1935 Tenodera sinensis Knutson and Jaques, Proc. Ia. Acad. Sci. 42:181.

Male green, green and brown or wholly brown with both tegmina and wings distinctly hyaline; pronotum subcarinate medially. Female body, legs and tegmina greenish, occasionally colored like male; tegmina subhyaline; pronotum strongly carinate behind transverse impression. Length of body, 83-104 mm.

This large "Chinese mantid" is a native of the subtropical regions of Asia from where it was accidentally introduced into Pennsylvania on some nursery stock about 1896. It has now become established in the north-eastern United States and efforts to introduce it into other parts of the country, including Iowa, have had varying success. While the Iowa introductions have failed, Gurney (42) reported founding of colonies of this insect in California and Illinois.

Specimens in the Iowa State College collection had been taken during the years of 1932 and 1937 indicating at least two attempts to add this species to the local fauna. The earlier date is represented by data which listed nymphs for July and adults for October. Only one specimen is in the collection for 1937. It is a mature nymph which was collected during August. Dr. H.H. Knight, who was active in this attempt to establish the form in Story County, said the egg masses which he kept under observation in the field were all eaten, probably by birds and possibly also mice. He concluded that the masses were too large and conspicuous to escape detection by these predators which would probably prevent establishment of the insect.

As to the several specimens in the Iowa Insect Survey Collection collected at Mt. Pleasant, Henry County, during November of 1931, Dr. H. E. Jaques (MS.) furnished information that not more than six egg cases had been placed out in the vicinity of the college the year previous. The above-mentioned specimens were taken the following year, but none have been found since that time. He added an interesting side note and remarked that one of the students had kept one adult well into the winter months by feeding it artificially with "meat and milk from a pipette."

Knutson and Jaques (86) listed the species for the state with the note, "An introduced species".

Subfamily THESPINAE Westwood

1889 THESPIDES Westwood, Rev. Mantid. p. 5.

Eyes usually large, round, prominent; vertex usually higher than eyes and more prominent next to them; pronotum prominently widened above

coxal insertions, metazona usually finely carinate; tegmina and wings of male normally present and with costal margin of former ciliated, in female greatly abbreviated or absent; front femora with three or four spines on lower face between marginal rows of spines; front tibiae (in our species) with two or more spines on upper side; hind tarsus with first segment longer than the following combined; cerci simple, rarely flattened.

One of the three United States genera of this subfamily has been reported as far north as eastern Nebraska and so should occur in Iowa.

Genus Oligonicella Giglio-Tos

1915 Oligonicella Giglio-Tos, Boll. Soc. Ent. Italiana, 46:190.

Slender, body strongly compressed; eyes large, prominent; ocelli large in male, small in female; vertex transversely ridged with tuberculate elevation near each eye; pronotum narrowest anterior to submedian dilation, margins more or less serrate, metazona shorter than front coxae; tegmina and wings of male membranous, reaching or surpassing apex of abdomen, in females absent; legs very slender, front tibiae with 4-6 spines.

Genotype: Oligonyx scudderi Saussure.

Two species occur north of Mexico.

Oligonicella scudderi (Saussure)

1870 Oligonyx scudderi Saussure, Mitth. Schweiz. Ent. Gesells. 3:239.

Color grayish, mottled with fuscous; male with tegmina and wings hyaline, somewhat clouded with fuscous; female with flight organs represented by slight lateral prolongations of hind angles of meso- and meta-thorax. Length of body, 34-37 mm. (Fig. 8).

With a range that extends from Florida to Texas in the Gulf States and northward to Missouri (specimens at hand), Kansas, and Nebraska, this species will undoubtedly be found in at least the southwestern part of Iowa.

Family PHASMIDAE¹ Leach

1815 PHASMIDA Leach, Edinburgh Encycl. 9:119.

The North American species of this family are all elongate, very slender and subcylindrical and lack tegmina and wings (one exception from southern Florida has tegmina represented by short pads); legs very long, usually slender, all three pairs being of nearly equal size; ovipositor concealed by genital plate; cerci not segmented.

The stick-like construction of the body and appendages cause these insects to resemble very closely the finer branches and twigs of the plants on which they live. This stick-like appearance has given rise to the very appropriate common name of "walking sticks". These insects spend most of their active life on plants, the leaves of which constitute their only source of foods. Upon reaching maturity in late summer, the walking

¹Roberts (128) presented evidence that the proper form for this name is PHASMATIDAE; but since most authors have used and apparently prefer the shorter version, that spelling is being retained here.

sticks mate and the females drop the eggs singly to the ground. The eggs look like small oval seeds and in some species are prettily marked with black and white. After lying dormant all winter the eggs hatch during the following spring and a tiny walking stick emerges to climb the stem or trunk of some plant and begin feeding on its foliage. Here it feeds until reaching maturity between July and September. The immature walking sticks have strong powers of reproducing their lost or broken legs. Even though such new limbs are usually smaller and have fewer tarsal segments than a normal leg, they are quite functional.

Like the Mantidae, this family is mainly a tropical one, having only a few species ranging as far north as Iowa. The principal works for this group in the United States were by Caudell (14, 17), Somes (146), and Hebard (67). The two genera and four species from the state belong to the subfamily BACUNCULINAE which may be characterized as follows:

Subfamily BACUNCULINAE Brunner

1893 BACUNCULIDAE Brunner, Ann. Mus. Civ. Stor. Nat. Genova, 33:80.

Head unarmed above, antennae longer than front femur; mesothorax at least four times as long as prothorax; tegmina and wings absent; basal abdominal tergite only slightly longer than broad; middle and hind tibiae neither deeply emarginate nor with a sunken pit below at apex; tarsi 5-segmented.

Two of the 7 genera known from the United States occur within Iowa.

Key to the Genera of BACUNCULINAE in Iowa

1. Head subquadrate or subcylindrical, distinctly longer than broad;
hind femur without a row of spines beneath. Diapheromera p. 191
- Head ovate, short, scarcely longer than broad; hind femur beneath
armed for full length with a row of stout spines. Megaphasma p. 192

Genus Diapheromera Gray

1835 Diapheromera Gray, Synop. Fam. Phasmidae, p. 18.

Head obliquely attached to thorax and about as long as the pronotum which is but one-fourth the length of mesonotum; middle femora of male swollen, thicker than hind ones and with a subapical spine beneath; cerci of male incurved, of female straight.

Genotype: Spectrum femoratum Say.

Of the nine species that occur north of Mexico, three have been found in Iowa.

Key to the Species and Subspecies of Diapheromera in Iowa

1. Hind femur with a stout spine beneath at apex 2
Hind femur not spined beneath at apex. D. blatchleyi blatchleyi p. 192
2. Middle femur of male banded with green and brown; cerci of female
less than half length of last abdominal segment. D. femorata p. 191
Middle femur of male not banded, uniformly colored; cerci of female
subequal to length of last abdominal segment. . D. velii velii p. 191

Diapheromera femorata (Say)

1824 Spectrum femoratum Say, in Long's 2nd Exped. St. Peter's River, 1:297.

1846 Spectrum femoratum Leidy, Proc. Acad. Nat. Sci. Phila. 3:146.

1868 Spectrum femoratum Scudder, Smithson. Misc. Publ. 8(2):76.

Color gray, green or brown, sometimes somewhat mottled with fuscous; male with head striped and middle femora banded, female not so marked; abdomen of female stout, of male slender. Length of body, 68-101 mm.

This arboreal species inhabits nearly all of the humid eastern North America. In the northern part of its range, which extends into Southern Canada, it is restricted to the area east of the Great Plains, while to the south it has followed favorable tree habitats as far west as New Mexico and Arizona.

In Iowa adults first appear in early August and are to be found from then until the killing frosts of autumn. Besides the two records of Leidy and Scudder cited above, the species has been listed for the state by Bessey (6), Osborn (98), Ball (2), Scudder (143), and was stated by Somes (146) to be "found throughout" Iowa; Knutson and Jaques (86) also gave it in their "Revised List."

Allamakee, Appanoose, Boone, Benton, Cedar, Dallas, Davis, Des Moines, Dickinson, Henry, Jefferson, Lee, Linn, Louisa, Muscatine, Polk, Poweshiek, Scott, Story, Wapello, and Woodbury counties.

Diapheromera velii velii Walsh

1864 Diapheromera velii Walsh, Proc. Ent. Soc. Phila. 3:410.

1916 Diapheromera veliei Somes, Ent. News, 27:270.

1920 Diapheromera veliei Blatchley, Orthop. North-Eastern Am. p. 137.

1928 Diapheromera veliei Hendrickson, Ann. Ent. Soc. Am. 31:122.

1930 Diapheromera veliei Hendrickson, Iowa State Coll. Jour. Sci. 4:58.

1931 Diapheromera veliei veliei Hebard, Proc. Acad. Nat. Sci. 83:131.

1934 Diapheromera veleii Hendrickson, Proc. Iowa Acad. Sci. 40:238.

Very similar to D. femorata but slightly smaller and separable therefrom chiefly by characters listed in the key. Length of body, 61-74 mm. (Fig. 6).

The nominal form of this species occurs in the Great Plains region from Colorado and New Mexico north and east to Minnesota, Iowa, Missouri, Oklahoma, and Texas. It is not a tree inhabitant like D. femorata but is to be encountered on clumps of prairie grasses.

Adults of this walking stick appear earlier in the season than do any of the other Iowa members of the family; records extended from July 9 to September 19. Hendrickson (71), in his prairie studies, found it "At all Andropogon communities . . . Numerous in some places." Other Iowa listings were given by Hebard (56, 59, 67) and Knutson and Jaques (86). In material studied, the sexes were present in equal numbers.

Audubon, Boone, Dickinson, Henry, Humboldt, Linn, Lyon, Mills, Muscatine, Plymouth, Sioux, Story, Woodbury, and Worth counties.

Diapheromera blatchleyi blatchleyi (Caudell)

- 1905 Bacunculus blatchleyi Caudell, Jour. N.Y. Ent. Soc. 13:212.
 1916 Manomera blatchleyi Simes, Ent. News, 27:271.
 1920 Manomera blatchleyi Blatchley, Orthop. North-Eastern Am. p. 140.
 1931 Diapheromera persimilis blatchleyi Hebard, Proc. Acad. Nat. Sci. Phila. 83:130.

Color green to green and slightly embrowned, male with pale lateral stripe extending from head to base of hind femora; head subcylindrical, slightly longer than pronotum; abdominal segments in male with VII and VIII equal and IX slightly longer, in female segment IX broadly emarginate, supra-anal plate small, triangular, carinate above. Length of body, 58-67 mm.

The general range of this species appears to be restricted to the north central part of the United States from Ohio west to Wisconsin, Nebraska, and Oklahoma. It is another tree-frequenting species.

In addition to the above-cited literature references, there was one more given by Hebard (59). The present species appears to be quite scarce in this state as only three collections of specimens were represented in the local material studied. These had been taken on July 30, August 23, and in September.

Cedar, Hamilton, and Muscatine counties.

Megaphasma Caudell

- 1903 Megaphasma Caudell, Proc. U.S. Nat. Mus. 26:878.

Pronotum about one-fourth length of mesonotum and with a deep, transverse impression medially; meso- and metanotum subequal in length, both finely carinate medially; middle and hind femora swollen in both sexes; male cerci stout, spatulate, decurved and incurved but not crossing; female cerci less than half as long as last abdominal segment.

Genotype: Diapheromera denticrus Stal.

The only species included in the genus has been recorded for the state.

Megaphasma denticrus (Stal)

- 1875 Diapheromera denticrus Stal, Recensio Orthop. 3:76.

Brownish yellow or fuscous, males sometimes marked with green or red, legs usually paler, and sometimes marked with gray; femora longitudinally carinate, the carinae either granulate or finely denticulate. Length of body, 98-150 mm.

This is a more southern species which ranges from Georgia and Alabama west to Texas and north in the central United States to Indiana and Iowa. It frequents trees and shrubs and is very similar to Diapheromera femorata in habits.

The records of Simes (146) (which were copied by Blatchley (8)), Knutson and Jaques (86), and Hebard (67) were all based on state collections. In addition, a single specimen in the Iowa Insect Survey collection, collected by H. Knutson on July 30, 1935, was available for study.

Boone, Fremont, Page, and Webster counties.

Family TETRIGIDAE¹ Serville

1839 TETRICIDITES Serville, Hist. Nat. Ins. Orthop. p. 570.

Eyes somewhat rounded, ocelli three in number; antennae usually cylindrical or filiform; face with prominent frontal costa; posterior prolongation of pronotum variable, reaching to or beyond apex of abdomen within many species; prosternum produced anteriorly as collar-like plate beneath head; tegmina rudimentary oval pads, wings usually present and showing development corresponding to that of posterior process of pronotum; legs variable, compressed, hind femora greatly enlarged; tibiae distinctly spined; front and middle tarsi 2-segmented, hind ones 3-segmented; arolia absent; males usually more slender than females, subgenital plate angular, conical, cerci small, cylindrical or conical; females with valves of ovipositor armed on outer edge with small rounded teeth, apices divergent.

These "pygmy" or "grouse" locusts are ground-inhabiting forms which may occur on wet sandy beaches, in woods, or in dry weedy fields. Some are quite good swimmers and seem to have no aversion to leaping into water to escape capture or pursuit. Hancock (44) recorded that they feed on "vegetable mold or decomposing soil sometimes mixed with algae, or on lichens, mosses, tender sprouting grasses, sedges, germinating seeds of plants and debris found in such situations." In a single year one complete life cycle and part of a second may be passed. In general, eggs are laid in the soil during spring and the resulting young attain adulthood by the following fall. After passing the winter hibernating beneath debris on the ground, the adults are ready to lay eggs the following spring.

Color is extremely variable and, with few exceptions, is practically worthless as a diagnostic character. Nabours (96) has found by means of breeding experiments that there are more than 100 color patterns that have a genetic basis, and that one species may exhibit a number of dominant patterns as well as several recessive ones. He has also found that the long and short forms of pronotum and hind wings which occur so frequently in species of this family are useless as taxonomic characters. They appear to result from various causes; in some forms these conditions result from environmental factors, while in at least one species they have a genetic basis and are said to constitute "a distinct Mendelian pair of characteristics with short dominant and long recessive."

Although the family is widely distributed over most of the world, many of the species break up into local or geographic races which were considered by earlier workers to represent full species.

The family has not been treated in its entirety for North America since Hancock's 1902 study; the same author gave a world-wide study in one fascicle of *Genera Insectorum* in 1906.

The two subfamilies that occur in Iowa may be separated by the key given below.

¹According to Roberts (128) the name Acrvadium belongs to a genus of oedipodine Acrididae and so cannot be used for a grouse locust. Therefore, the next available name, Tetrix, must be used here. This also causes the family name to be changed.

Key to the Subfamilies of TETRIGIDAE in Iowa

1. Antennae with 12-14 segments; tegmina without subapical pale dot TETRIGINAE p. 194
- Antennae with 22 segments; tegmina with subapical, calloused pale spot (Fig. 10) BATRACHIDINAE p. 200

Subfamily TETRIGINAE Serville

1839 TETRIGIDITES Serville, Hist. Nat. Ins. Orthop. p. 570.

Frontal costa more or less forked above ocellus; antennae inserted opposite lower margin of eyes; pronotum strongly tapering posteriorly, usually flattened above with median dorsal carina elevated; front femora more or less compressed and carinate above; hind tarsi with segment I distinctly longer than III.

Three genera of the present subfamily occur in Iowa.

Key to the Genera of TETRIGINAE in Iowa

1. Pronotum (in cross-section) tectate above, median carina elevated in its full length and usually produced as a strong angle over base of head Nomotettix p. 194
- Pronotum flat, or at most only slightly tectate, median carina never crest-like for more than anterior third nor angled over base of head 2
2. Eyes large, width of one of them at least as wide as vertex; eyes nearly or quite in contact with front margin or pronotum Paratettix p. 199
- Eyes smaller, width of one of them less than width of interocular space; eyes well separated from front margin of pronotum (Figs. 38, 39) Tetrix p. 196

Genus Nomotettix Morse

1894 Nomotettix Morse, Psyche, 7:150.

Head inserted into prothorax to eyes; fastigium rounded or angulate and distinctly surpassing anterior margin of eyes; vertex usually with a pair of tubercles behind middle of eyes; frontal costae strongly emarginate between eyes; tegmina narrow, tips obtuse; hind tarsus with segment I much longer than II and III combined.

Genotype: Batrachidea cristata Scudder.

Two species occur in Iowa.

Key to the Species of Nomotettix in Iowa

1. Dorsal outline of pronotal crest almost straight, distinctly arcuate anteriorly only; fastigium (in profile) extending far anterior to frontal costa (Fig. 35) N. parvus p. 194
- Dorsal outline or pronotal crest arcuately elevated for nearly its full length (Figs. 36, 37); fastigium not exceeding frontal costa in profile (see p. 195 for key to subspecies) N. cristatus p. 195

Nomotettix parvus Morse

1895 Nomotettix parvus Morse, Jour. N.Y. Ent. Soc. 3:14.

Vertex projecting anteriorly to eye about two-thirds length of an eye; front margin of vertex obtusely angled, sides nearly straight, median carina (viewed from above) only slightly projecting; frontal costa (profile) shallowly emarginate between eyes; anterior margin of pronotum projecting slightly over vertex as an obtuse angle; dorsum scabrous. Length of body, 6.5-8.5 mm.

This species has been reported for Kansas, Minnesota, and Illinois.

A single state specimen was studied. It was a male collected near Lamoni, Decatur County, July 26, 1933, by H.M. Harris.

Nomotettix cristatus (Scudder)

1862 Batrachidea cristata Scudder, Jour. Boston Soc. Nat. Hist. 7:478.

Grayish or fuscous brown, pronotal disk frequently ornamented with several triangular black or black-and-white spots; vertex much wider than an eye; frontal costa deeply sinuate opposite middle of eyes; pronotum and wings usually of the short form; former slightly surpassing and latter not quite reaching apex of abdomen; in long form tegmina and wings distinctly surpassing apex of abdomen. Length of body, 7.1-12.5 mm.

The general range of the species is in the area from Ontario to South Dakota and south and southwest to Florida, Oklahoma, and Texas. In this broad range the species breaks up into several moderately weak subspecies, two of which may be considered members of Iowa's fauna.

Key to the Subspecies of Nomotettix cristatus in Iowa

1. Median carina of pronotum cristate, dorsal outline flattened above humeral angles (Fig. 37); punctations of carina not translucent N. cristatus cristatus p. 195
- Median carina of pronotum cristate, dorsal outline continuously curved, not flattened (Fig. 36), punctures of carina translucent N. cristatus compressus p. 195

Nomotettix cristatus cristatus (Scudder)

1862 Batrachidea cristata Scudder, Jour. Boston Soc. Nat. Hist. 7:478.

This most northern race occurs as far south as North Carolina and southern Illinois so it should occupy most of Iowa.

Even though general distribution records indicate that this species probably belongs to the local insect fauna no Iowa specimens were available for study nor has it ever been reported for the state.

Nomotettix cristatus compressus Morse

8895 Nomotettix compressus Morse, Jour. N.Y. Ent. Soc. 3:15.

This race is the southeastern representative of the species. It is known to occur as far north as Ohio, Indiana, and southern Illinois with a limited number of specimens reported for southeastern Iowa.

This race was twice reported for the state, once by Knutson and Jaques (86) and once by Knutson (85). From these sources the data given below

were obtained. The latter reference stated that specimens had been collected between May 12 and October 15 and reported that "At Oakland Mills State Park more than 200 specimens were taken in short grass along a railroad track, near a dense woods ... These specimens appear to be intermediate between the two races." Some of these specimens were available for study in the Iowa Insect Survey collection.

Cedar, Des Moines, and Henry counties.

Genus Tetrix Latreille

1802 Tetrix Latreille, Hist. Nat. Crust. Ins. 3:284.

Vertex rounded or angled anteriorly, distinctly produced in front of eyes; pronotum with median carina, at least in part, distinctly but not cristately elevated; hind tibiae feebly enlarged near apex; hind tarsal I distinctly longer than III.

Genotype: Acrydium subulatum Fabricius.

At present four nominal forms are known to occur in Iowa.

Key to the Species and Subspecies of Tetrix in Iowa

1. Vertex triangularly produced beyond eyes, sides straight, median carina not projecting when viewed from above (Fig. 39) . . .
 T. granulatus p. 196
 Vertex with sides convex, median carina projecting when viewed from above (Fig. 38). 2
2. Median carina of pronotum elevated anteriorly; this raised part bullate and remote from front margin of pronotum and almost abruptly terminated posteriorly; lateral carinae of prozona noticeably convergent posteriorly . . T. arenosus angustus p. 199
 Median carina of pronotum gradually rising from anterior margin of pronotum; lateral carinae of prozona parallel 3
- 3.¹ Size larger, form less robust. Pronotum showing trace of tectation. Fastigium often showing very weak indication of triangular production T. acadicus acadicus p. 198
 Size smaller, form less robust. Pronotum showing no trace of tectation. Fastigium normally showing less production . .
 T. ornatus p. 197.

Tetrix granulatus (Kirby)

1837 Acrydium granulatum Kirby, Faun. Bor. Am. Ins. 4:251.

1877 Tettix granulata Bessey, 7th Bienn. Rept. Iowa State Coll. p. 210.

1892 Tettix granulata Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Tettix granulata Ball, Proc. Iowa Acad. Sci. 4:238.

1902 Tettix granulatus Hancock, Tettigidae of North America, p. 71.

¹This couplet is an exact copy (except for the form of the names) from Hebard (63). Due to a typographical error the first half reads "form less robust" while it should have been "form more robust." See specific discussion of T. ornatus for further comments on separation of these two nominal species.

- 1915 Tettix granulatus Somes, 15th Rept. St. Ent. Minn. p. 11.
 1935 Acrydium subulatum Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.

1937 Acrydium subulatum Knutson, Field and Laboratory, 5:39.

Vertex meeting face at acutely rounded angle, face very oblique; eyes small; pronotum of long form attenuate apically, median carina prominent throughout but in no part crested; surface of pronotum and legs granulate, sometimes with noticeable rugae. Length of body, 8.5-15.3 mm.

Although Hebard (63) considered this form synonymous with the pale-arctic "subulata," more recent work by Rehn (114) resulted in the resurrection of the present name "for the North American representative of the subulata species group." It is a boreal species of wide distribution in North America where it ranges as far south as northern Illinois, Iowa, and Nebraska.

Locally this appears to be an uncommon species. Adults have been collected from May through August and nymphs during September. Somes (loc. cit.) wrote of finding "a colony of this species in a sandy field in Iowa at least a mile from any stream or body of water. In this instance it was in a cultivated field and feeding upon the tender stems of young grain. . ." Knutson (85) reported that he had taken it "along the Mississippi River south of McGregor along the edge of a dense woods, which contained an unusually thick layer of dead leaves."

Clayton, Dickinson, Kossuth, Story, and Winnebago counties.

Tettix ornatus (Say)

- 1824 Acrydium ornatum Say, Am. Ent. 1:10.
 1877 Tettix ornata Bessey, 7th Bienn. Rept. Iowa State Coll. p. 210.
 1892 Tettix ornata Osborn, Proc. Iowa Acad. Sci. 1(2):117.
 1897 Tettix ornatus Ball, Proc. Iowa Acad. Sci. 4:238.
 1902 Tettix ornatum Hancock, Tettigidae North American, p. 79.
 1930 Acrydium ornatum Hendrickson, Iowa State Coll. Jour. Sci. 4:58.
 1935 Acrydium ornatum Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.
 1935 Acrydium ornatum hancocki Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.

1937 Acrydium ornatum Knutson, Field and Laboratory 5:39.

Frontal costa slightly sinuate between eyes; surface of pronotum and legs finely granulate, posterior half of pronotum with faint to distinct longitudinal rugae; median carina of pronotum distinct throughout. Length of body, 8.5-13.5 mm.

This very common species has a wide range north and east of the Great Plains from Alberta to Ontario and south to North Carolina, Mississippi, Missouri, and Kansas, while west of that region it extends south along the eastern slopes of the Rocky Mountains to New Mexico and Texas. It frequents a variety of habitats and may be found along bodies of water, sparsely grown fields and hillsides or along edge growth of woods.

Adult records available during this study were for the period from March 25 to November 16, indicating that that stage occurs within Iowa during every month of the year.

In his monographic treatment of the "Tettigidae of North America," Hancock (44) divided this genus into three "groups." One of these was

the "Ornatus Group." Since that time the various names included therein have been reduced in number through being synonymized until now but two species remain, T. ornatus and T. acadicus and these are so closely allied that the feasibility of keeping them separate is open to serious question. The characters which Hebard used to separate them have already been copied into the key so that the reader might evaluate them for himself. These characters are either so vague as to be meaningless or are contradicted by Hebard himself in text comments on the species concerned. Considering these characters in order, the first concerns size and robustness and was commented upon by Hebard (59) in his Illinois paper when he wrote of specimens of T. ornatus which were "unusually large and robust with mediolongitudinal carina of pronotum slightly more decided than usual and are consequently difficult to separate from small individuals of T. acadicus acadicus." Such comments would seem to invalidate size and robustness. As to the difference between "showing a trace of tectation" vs. "showing no tectation" and "often showing very weak indication of triangular production" vs. "normally showing less production" (if there can be such a condition of "less" than a "very weak indication") one wonders if perhaps imagination had not been used in lieu of valid characters. During this study the final breakdown of these characters appeared in a small series of each species identified by Hebard for his Illinois paper. In these series specimens of both species showed appreciable tectation of the pronotum with the most prominent development of the condition being labelled T. ornatus in contradiction to statements given in the key. Because of the absence of characters to effectively separate these two nominal species, all specimens viewed during this study and not previously determined by Hebard or other authority as T. acadicus or one of its synonyms have been included under the name T. ornatus.

Appanoose, Clay, Clarke, Decatur, Des Moines, Dickinson, Fremont, Guthrie, Hancock, Hardin, Henry, Humboldt, Jefferson, Johnson, Kossuth, Linn, Monroe, Polk, Sioux, Story, Van Buren, Washington, and Winnebago counties.

Tetrix acadicus acadicus (Scudder)

- 1875 Tettigidea acadica Scudder, Dawson Rept. Geol. 49th Paral. p. 345.
 1899 Tetrix hancocki Morse, Jour. N. Y. Ent. Soc. 7:201.
 1902 Tettix hancocki Hancock, Tettigidae North America, p. 82.
 1906 Tetrix hancocki Hancock, 48th Fasc. Gen. Insectorum, p. 59.
 1906 Tetrix hancocki abbreviata Hancock, ibid. p. 59.
 1935 Acrydium acadicum acadicum Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.

- 1935 Acrydium acadicum acadicum Knutson, Field and Lab. 5:39.

This species is very closely allied to T. ornatus; see key and discussion under that species for separation of the two.

The range of this species, which is said to extend from Ontario to Manitoba and south to Michigan, Minnesota, Nebraska, and northern New Mexico, is encompassed by that of T. ornatus, another factor to be considered when evaluating the transitional type of minor variations which are used to separate the two.

The data included below are based chiefly on Knutson's (85) notes. He reports collecting specimens in cornfields, woods, and meadows between

October 10 and 21. Two specimens of the series of Iowa specimens from which the acknowledged synonym T. hancocki was in part described were examined in the collection of Iowa State College.

Cedar, Des Moines, Dickinson, Henry, Iowa, Johnson, Sioux, and Story counties.

Tetrix arenosus angustus (Hancock)

- 1896 Tettix angustum Hancock, Trans. Am. Ent. Soc. 23:238.
 1892 Tettix femoratus Osborn, Proc. Iowa Acad. Sci. 1(2):117.
 1897 Tettix arenosus Ball, Proc. Iowa Acad. Sci. 4:238.
 1902 Tettix arenosus Hancock, Tettigidae North America, p. 86.
 1902 Tettix obscurus Hancock, Ibid. p. 88.
 1902 Tettix gibbosus Hancock, Ibid. p. 89.
 1906 Tetrix arenosa Hancock, 48th Fasc. Gen. Insectorum, p. 59.
 1906 Tetrix gibbosa Hancock, Ibid. p. 59
 1906 Tetrix obscura Hancock, Ibid, p. 59
 1935 Acrydium arenosum angustum Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.
 1937 Acrydium arenosum angustum Knutson, Field and Lab. 5:39.

Vertex very slightly depressed at apex, fastigium slightly surpassing eyes and nearly truncated, median carina low on disk and projecting anteriorly; frontal carinae distinctly sinuate opposite lower half of eyes; pronotal surface flat, median carina not raised except anteriorly as described in key; lateral margins behind humeri slightly reflexed to apical third; surface somewhat irregularly granulate. Length of body, 11-13.9 mm.

This is the northern race of an eastern species. Its known range extends from Nova Scotia and Ontario in Canada south and west to North Carolina, Tennessee, Oklahoma, Minnesota, and Nebraska and is the only form of this species detected among local material. Woods and dry, somewhat sparsely weeded fields are inhabited by this very common grouse locust. It is only uncommonly found close to water.

Adults are known to occur the year around in this state as elsewhere. Both the long and short forms are well represented in the large series available. The species listed for the state by Osborn (loc. cit.) as "Tettix femoratus" is considered to be this without question because true T. femoratus is a southern species and such a common species as T. arenosus was surely represented in the material available to Osborn. Since the name T. arenosus did not appear in literature until after Osborn's paper, such an erroneous determination would not be surprising.

Appanoose, Boone, Bremer, Buchanan, Buena Vista, Cedar, Clay, Clayton, Delaware, Des Moines, Dubuque, Fremont, Greene, Guthrie, Hancock, Hardin, Henry, Iowa, Jackson, Jefferson, Johnson, Jones, Lee, Linn, Louisa, Mahaska, Mills, Muscatine, Polk, Scott, Sioux, Story, Van Buren, Wapello, Washington, Wayne, Webster, and Woodbury counties.

Genus Paratettix Bolivar

- 1887 Paratettix Bolivar, Ann. Soc. Ent. Belgique, 31:270.

Vertex short, not surpassing front margin of eyes, disk longitudinally concave either side of median line; facial carinae prominent only between bases of antennae; pronotum with dorsum flat, slightly convex between humeri, median carina quite low.

Genotype: Tetrix meridionalis Rambur.

One species occurs in Iowa.

Paratettix cucullatus cucullatus (Burmeister)

1838 Tetrix cucullatus Burmeister, Handb. Ent. 2:658.

1877 Tettix cucullatus Bessey, 7th Bienn. Rept. Iowa State Coll. p. 210.

1892 Tettix cucullatus Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Tettix cucullatus Ball, Proc. Iowa Acad. Sci. 4:238.

1902 Paratettix cucullatus Hancock, Tettigidae N. Am. p. 112.

1930 Paratettix cucullatus Hendrickson, Iowa State Coll. Jour. Sci. 4:58.

Vertex with median carina low, slightly projecting anteriorly; pronotum distinctly surpassing tips of hind femora, median carina feebly elevated; tegminal sinus much shallower than lower one; tegmina narrowed apically, tips acuminate. Length 10–15.5 mm. (Fig. 9).

The range of this race extends from Ontario to Florida west to South Dakota, Colorado, and Kansas into Oklahoma. The favored habitat for imagoes and the young of this common species is the damp sandy or muddy shores of bodies of water.

All adult Iowa specimens seen during this study have been of the long form. They had been collected between March 25 and December 23, a period which gives definite indication that they hibernate as adults. Nymphal specimens bore date labels from March 11 to October 17. Additional reports were given by Somes (145), Knutson and Jaques (86), and Knutson (85).

Appanoose, Boone, Cedar, Clarke, Clay, Clayton, Clinton, Delaware, Des Moines, Dickinson, Fremont, Henry, Howard, Iowa, Jackson, Jefferson, Johnson, Jones, Lee, Linn, Louisa, Mahaska, Marion, Mills, Monona, Muscatine, Osceola, Page, Palo Alto, Ringgold, Sac, Scott, Sioux, Story, Union, Van Buren, Washington, Wayne, and Webster counties.

Subfamily BATRACHIDINAE Bolivar

1887 BATRACHIDEAE Bolivar, Ann. Ent. Soc. Belgique 31:195.

Frontal costa narrow, continuous with median carina of vertex; eyes emarginate above by lobes of vertex; antennae inserted above lower border of eyes; pronotum tectate dorsally, median carina never more than carinate; hind tarsal segment I not longer than III.

One genus occurs in Iowa.

Genus Tettigidea Scudder

1862 Tettigidea Scudder, Boston Jour. Nat. Hist. 7:476.

Vertex equal to or wider than width of one eye and usually surpassing front margins of eyes; frontal costa broadly rounding into median carina of vertex, without a sinuation between eyes; pronotum elongate, lateral carinae of prozona present; surface finely granulose, usually with distinct longitudinal rugae; median carina of pronotum distinct but not prominent.

Genotype: Acrydium laterale Say.

Three species are known from the United States, one of which occurs in Iowa.

Tettigidea lateralis (Say)

1824 Acrydium laterale Say, Am. Ent. 1:10.

- 1877 Tettigidea polymorpha Bessey, 7th Bienn. Rept. Iowa State Coll. p. 210.
 1897 Tettigidea parvipennis Ball, Proc. Iowa Acad. Sci. 4:238.
 1902 Tettigidea parvipennis pennata Hancock, Tettigidae North America, p. 146, 147.
 1930 Tettigidea lateralis parvipennis Hendrickson, Iowa State Coll. Jour. Sci. 4:58.
 1935 Tettigidea lateralis parvipennis Knutson and Jaques, Proc. Iowa Acad. Sci. 42:181.
 1938 Tettigidea lateralis parvipennis Knutson, Field and Lab. 5:40.

Vertex very slightly produced beyond front margin of eyes, median carina absent basally; pronotum convex between and in front of humeri, median carina more prominent anteriorly; tegminal sinus more acute than lower one; hind femoral margins entire, upper and outer surfaces granulate and somewhat ridged; front margin of pronotum obtusely angled, not surpassing middle of eyes. Length of body, 8-17 mm. (Fig. 10).

This species ranges from Ontario in southern Canada south in the United States to the Gulf States and west to Minnesota, Oklahoma, and New Mexico. It inhabits areas of moist sand or soil close to the water.

The division of this species into two "weakly defined" races (northern, "more robust" = T. parvipennis Harris; southern, "more slender" = typical T. lateralis Say) was maintained but with serious question by Hebard (56, 59). The evidence he presented suggests that considering T. lateralis a variable species may be preferable to treating it as composed of distinct subspecies.

Although material from one state is not sufficient to draw conclusions about geographic forms, the available Iowa specimens show gradual rather than discontinuous differences between individuals regardless of the collecting areas making separation of locals quite arbitrary. Therefore, for the purpose of this paper, no racial separation of the species has been made.

Adult specimens studied had been collected between February 19 and August 26; nymphs, all fully grown, were taken during August. The species was listed for the state by Bessey (6).

Appanoose, Boone, Cedar, Clarke, Clay, Clayton, Delaware, Des Moines, Dickinson, Dubuque, Hancock, Henry, Iowa, Jefferson, Johnson, Lee, Linn, Louisa, Mahaska, Monroe, Muscatine, Page, Polk, Scott, Story, Van Buren, Wapello, Washington, Webster, and Woodbury counties.

Family ACRIDIDAE Latreille

1825 ACRIDITES Latreille, Fam. Règne Animal. p. 414.

Head variable from short and swollen to markedly extended horizontally; antennae filiform or variously flattened or broadened at base or apex; ocelli present and foveolae usually so; pronotum somewhat saddle-shaped, variable in detailed structure and form; tegmina and wings present or absent; when present, fully developed or greatly reduced in length and size; front and middle legs subequal in development, much smaller and shorter than hind ones; tarsi three-segmented with basal segment usually the longest; ovipositor consisting of four short, "horny" valves, dorsal pair curving upward, ventral pair curving downward.

The "grasshoppers" do not all live among grasses as one might assume from this common name. Some are to be found among marsh plants, some on weeds, some on cultivated crops, while still others spend much of their time in trees. With few exceptions all Iowa members of this insect family pass the winter in the egg stage. Whether the eggs are laid in the soil, as is usual, or in rotting stumps or other material, they are usually placed in a hole which the female forms with her abdomen. Only occasionally does a female vary this habit and use a hole already present. The eggs, usually numbering from thirty to sixty, are neatly arranged in rows and covered with a gelatinous fluid which hardens to form a firm case around them. The tiny, wingless grasshoppers which hatch from these eggs require most of the warm part of the year and much plant food to mature and produce eggs to carry the species through the adversities of another winter. These young ones, especially after they begin to develop wings, may be confused with some of the short-winged adults, but are easily differentiated therefrom by the position of the wing pads. In the young, or nymphs, the hind wings overlap the front ones and the costal margins are held upward; this is the exact opposite of the adults in which the front wings overlap the hind ones and the costal margins are carried downward. A few of the species may hibernate as nymphs while a few others survive the cold in the adult stage.

Roberts (129) presented a valuable comparative study of the subfamilies based on genitalic characters.

The 83 Iowa species represent four subfamilies which may be separated by the key given below.

Key to the Subfamilies of ACRIDIDAE in Iowa

- 1. Sternum not spined between bases of front legs 2
Sternum with a prominent, erect, stout spine between bases of front legs (Fig. 40) 3
- 2. Hind margin of pronotum truncate, convex or weakly and very obtusely angled; face usually distinctly oblique and meeting at an acute angle (Fig. 13); hind wings uniformly hyaline, never brightly colored nor with a dark crossband . . ACRIDINAE p. 202
Hind margin of pronotum strongly, usually acutely angled; face usually vertical and rounding into vertex; hind wings usually brightly colored and with a dark crossband beyond middle. (Fig. 11) OEDIPODINAE p. 221
- 3. Hind tibiae with outer row of dorsal spines extending to apex ROMALEINAE p. 243
Hind tibiae with outer row of dorsal spines terminating before apex CYRTACANTHACRIDINAE p. 244

Subfamily ACRIDINAE Latreille

1825 ACRIDITES Latreille, Fam. Règne Animal. p. 414.

The species included in this subfamily are separated with difficulty from the Oedipodinae. Even those characters used in the key above, while reasonably reliable for local material, do not always hold in other parts of the country. Roberts' (129) study of phallic structures also failed to find any marked differences between the two.

Many members seek out the moister meadows and borders of marshes; these are rarely of any importance to our crops. However, those species which inhabit sandy or clayey fields or drier conditions are often numbered among the more serious enemies of cultivated plants, especially in the more western part of the country. In Iowa all species pass the winter in the egg stage. The males are able to produce rasping sound by rubbing the inner surface of the hind femora (which is roughened by a row of minute pegs) across the edge of the tegmina. This sound, which is thought to be a mating call by which the male calls the female, appears to be different and characteristic for many species.

The important references for this subfamily were by McNeill (90) and Hebard (52, 61).

Sixteen of the thirty-nine genera known from North America occur within the state.

Key to the Genera of Acridinae in Iowa

1. Lateral foveolae absent or not visible from above 2
 Lateral foveolae present and visible from above, sometimes very weak (Fig. 46) 12
2. Antennae flattened and strongly widened at base, tapering strongly to apex from near base 3
 Antennae neither strongly flattened and widened at base nor strongly tapering 6
3. Apices of tegmina strongly obliquely truncated . . . Metaleptea p. 205
 Apices of tegmina rounded, not truncated 4
4. Vertex with a distinct median carina 5
 Vertex with median carina obsolete or absent; head and upper half of lateral lobes of pronotum with a distinct, broad, post-ocular dark stripe Mermiria p. 206
5. Costal area of tegmina with five or six close, regular, longitudinal veins; size larger, 25 mm. or longer . . . Pseudopomala p. 204
 Costal area of tegmina with but two or three longitudinal veins in basal third; size smaller, length less than 25 mm. . . Opeia p. 205
6. Hind femora not trifasciate with black externally; hind tibiae not bluish 7
 Hind femora conspicuously trifasciate with black externally; hind tibiae bluish Amphitornus p. 208
7. Apex of antenna weakly to strongly flattened, appearing clubbed; head and usually pronotum with a weak, irregular, longitudinal carina either side of median one Eritettix p. 209
 Apex of antenna neither flattened nor clubbed 8
8. Lateral carinae of pronotum not parallel, at least distinctly diverging posteriorly on metazona 9
 Lateral carinae of pronotum parallel or subparallel throughout; hind tibiae buff or brown Dichromorpha p. 213
9. Hind tibiae strongly reddish Chloealtis p. 214
 Hind tibiae never reddish 10
10. Hind tibiae with 18-23 spines on outer hind margin . . . Syrbula p. 207
 Hind tibiae with 12-15 spines on outer hind margin 11
11. Height of an eye greater than length of subocular suture Phlibostroma p. 211

- Height of an eye less than length of subocular suture. Orphulella p. 211
12. Antennae weakly to strongly flattened apically and appearing clubbed Aeropedellus p. 216
- Antennae neither flattened nor clubbed apically 13
13. Inner apical spurs of hind tibiae not equal in length 14
- Inner apical spurs of hind tibiae equal in length and wholly dark brown or black, shining Stethophyma p. 216
14. Lateral foveolae and their defining carinae very weak to obsolete; vertex inflated, with at most a very weak fastigial impression Boopedon p. 219
- Lateral foveolae well defined by strongly calloused carinae; vertex with a strong fastigial impression 15
15. Hind tibiae reddish with a distinct, sub-basal white ring Ageneotettix p. 218
- Hind tibiae not reddish 16
16. Pronotum with lateral carinae calloused and distinct for full length; hind tibiae yellow Chorthippus p. 215
- Pronotum with lateral carinae absent or only weakly developed on metazona; hind tibiae blue Aulocora p. 220

Genus Pseudopomala Morse

1896 Pseudopomala Morse, *Psyche* 7:325.

Head subcylindrical, face and eyes strongly oblique; vertex strongly rounded and surpassing eyes by a distance equal to its basal width; pronotum about twice as long as broad, sides vertical, median and lateral carinae prominent and cut behind middle by principal sulcus; hind legs very long and slender, hind femora reaching nearly or quite to apex of abdomen.

Genotype: Opomala brachyptera Scudder.

The single known species of this genus occurs in Iowa.

Pseudopomala brachyptera (Scudder)

1862 Opomala brachyptera Scudder, *Boston Jour. Nat. Hist.* 7:454.

1892 Mermiria brachyptera Osborn, *Proc. Iowa Acad. Nat. Sci.* 1(2):118.

Color brownish above to yellowish below, upper surface of head and pronotum sometimes with small, rounded black dots; pronotum with hind margin very weakly angled, metazona two-thirds as long as prozona, its surface irregularly rugose; tegmina usually not more than slightly surpassing middle of abdomen, sometimes fully developed. Length of body, males, 25–28 mm; females, 30–36 mm.

This is an inhabitant of grass clumps, especially Andropogon, which grow on poor soil. It has a discontinuous range across southern Canada and the northern United States, ranging as far south, in this latitude, as central Illinois, northern Missouri, and Kansas.

Local nymphal records were available for May, June, and July, with adult specimens showing for the period from July 2 until September 12.

References to the local occurrence of this form were given by McNeill (91), Ball (2), Somes (100, 101), Hebard (53, 56), Hendrickson (70, 71), Knutson and Jaques (86), and Knutson (85).

Buena Vista, Cedar, Cherokee, Dickinson, Dubuque, Fremont, Johnson, Lyon, Muscatine, Plymouth, Sioux, Story, and Woodbury counties.

Genus Metaleptea¹ Brunner

1893 Metaleptea Brunner, Ann. Mus. Civ. Stor. Nat. Genova 33:118.

Head conical, front and eyes strongly oblique; vertex horizontal and distinctly surpassing eyes; frontal costa narrow, slightly divergent below, sulcate; pronotum tricarinate, disk flat, principal sulcus behind middle; lateral lobes vertical, slightly longer than high; tegmina and wings fully developed, surpassing apices of hind femora; latter slender, reaching or exceeding apex of abdomen.

Genotype: Gryllus brevicornis Johannson.

According to Rehn (111) only one species belongs to this genus; it probably will be found in the eastern part of the state.

Metaleptea brevicornis brevicornis (Johannson)

1764 Gryllus brevicornis Johannson, Amoen. Acad. 6:398.

Male usually pale brown with face, dorsum and front and middle legs bright green. Females either uniformly brown or green with brown mottlings on tegmina. Pronotal carinae cut by transverse sulci. Length of body, males, 19-25 mm.; females, 23-35 mm.

This species, which was long placed in the genus Tryxalis in American literature, ranges from New York and Ontario south to Florida and west to Wisconsin, Missouri (specimens in author's collection), Arkansas and Texas thence south into Mexico. It occurs only among marsh vegetation along bodies of water.

The general range of this seldom-encountered slant-faced grasshopper indicates that it may occur along the Mississippi River in the eastern part of Iowa.

Genus Opeia McNeill

1897 Opeia McNeill, Proc. Davenport Acad. Sci. 6:214.

Head and eyes moderately to strongly oblique, vertex distinctly surpassing eyes; pronotum narrow, sides almost vertical, disk tricarinate and cut behind middle by principal sulcus; hind margin slightly rounded; tegmina and wings variable in length from three-fourths as long as abdomen to distinctly surpassing its apex.

Genotype: Oxycoryphus obscurus Thomas.

Of the three species in the genus only one occurs in Iowa.

Opeia obscura (Thomas)

1872 Oxycoryphus obscurus Thomas, Prel. Rept. U.S. Geol. Surv. Mont. and Terr. 5:466.

¹Rehn (111) stated that the author for this genus must be Giglio-Tos (31) because as originally proposed by Brunner (12) it included no species and so was invalid. However, Gurney (40) showed earlier that the name had been proposed "in a sense that is unquestionably binary, thereby giving the name validity.

Color brown or greenish with fuscous or black markings on head, thorax, and tegmina; antennae yellow, reddish or fuscous; pronotal disk slightly tectate, the carinae percurrent, lateral ones thicker and more strongly calloused. Length of body, 13-22.5 mm.

The range of this Great Plains species extends as far north and east as Minnesota and western Iowa. Short prairie grasses comprise the usual type of habitat frequented by this grasshopper.

All Iowa specimens of which only one bore fully developed wings, were collected during July and August in the northwestern part of the state. Previous local records were given by Knutson and Jaques (86), and Knutson (85).

Dickinson, Lyon, Plymouth, and Sioux counties.

Genus Mermiria Stal

1873 Mermiria Stal, Reconsio Orthop. 1:90.

Head long, subequal to length of pronotum, slightly ascending anteriorly; vertex triangular or semi-elliptical with margins raised and apex acute or rounded; face strongly oblique, frontal costa prominent, distinctly sulcate above ocellus; pronotum flattened to convex, median carina distinct, percurrent, lateral carinae varying from absent to distinct; metazona shorter than prozona, hind margin truncate, rounded or broadly and obtusely angled; lateral lobes of pronotum convergent downward, lower margin sinuate, horizontal; tegmina and wings fully developed, equaling or surpassing apex of abdomen; prosternum with a short, obtuse tubercle.

Genotype: Opomala neomexicana Thomas.

State records are available for three of the six species which Rehn (109) reported for the United States.

Key to the Species of Mermiria in Iowa

1. Lateral carinae of pronotum present and distinct; sides of vertex rounded, meeting in a broad curve. M. neomexicana p. 206
 Lateral carinae of pronotum absent 2
2. Male without a pale subcostal stripe on basal half of tegmina;
 vertex with a more or less distinct median carina
 M. bivittata p. 207
- Male with a pale subcostal stripe on basal half of tegmina;
 vertex without a median carina . M. maculipennis macclungi p. 207

Mermiria neomexicana (Thomas)

1870 Opomala neomexicana Thomas, Proc. Acad. Nat. Sci. Phila. p. 77.

Color pale brown, head and costal area of tegmina sometimes greenish and the dorsal area of latter washed with reddish; tegmina without a pale subcostal stripe on basal half; hind tibiae reddish; tegmina and hind femora reaching apex of abdomen. Length of body, males, 27-35 mm.; females, 37-52 mm.

This species ranges from Illinois to Montana and south to Texas, Arizona, and Mexico. It frequents drier hill habitats. In Iowa it is apparently restricted to the westernmost part of the state where it occurs along the dry, sandy, loess bluffs. Nymphal data indicated fully-grown specimens for July, while adult data showed their period to be from July 26 to September 25. State records were given by Rehn (109), Hebard (51, 53,

54, 55), Hendrickson (71), Knutson and Jaques (86), and Knutson (85).

Fremont, Harrison, Mills, Plymouth, Pottawattamie, and Woodbury counties.

Mermiria bivittata (Serville)

1839 Opsomala (!) bivittata Serville, Hist. Nat. des Ins., Orthop, p. 589.

1877 Opomala bivittata Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.

1914 Mermeria (!) bivittata Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. 141. p. 17.

1915 Mermeria (!) bivittata Somes, 15th Rept. St. Ent. Minn. p. 17.

Color greenish to yellow-green with tegmina brownish, females often tinged above with purple; females with a pale subcostal stripe on basal third of tegmina; hind femora reddish- or purplish-brown, hind tibiae red; head shorter than pronotum; hind margin of pronotum broadly and obtusely angled; tegmina slightly surpassing apex of abdomen. Length of body, males, 29-37 mm.; females, 40-51 mm.

This is a southern species which ranges across the southern United States from Florida to Texas and north to Illinois, Iowa, and Nebraska. It is an inhabitant of richer grass growths in fields and woods.

Although but a single specimen was available for study, a number of references to its occurrence here appeared in literature: Osborn (98), Ball (2), Somes (145), Rehn (147), Blatchley (8), Hebard (55), Knutson and Jaques (86), and Knutson (85). The date on the single specimen was August, 1938.

Lee and Woodbury counties.

Mermiria maculipennis macclungi Rehn

1919 Mermiria maculipennis macclungi Rehn, Proc. Acad. Nat. Sci. Philadelphia 1919, p. 11.

Color pale brown or yellowish; both sexes with a subcostal pale stripe along basal third of tegmina; antennae and hind tibiae reddish; pronotum faintly or not at all constricted at middle, hind margin rounded or slightly angled. Length of body, males, 26-32 mm.; females 36-45 mm.

The known range of this race extends from Illinois to Montana and Utah and south to Missouri and Kansas. In the latter state it shows some tendency toward the typical form which occurs in the southwestern United States. Like its congener, M. neomexicana, this species frequents dry sandy soil with a short, sparse, vegetative cover.

This is by far the most common species of the genus within Iowa. Adults records indicated occurrence from July 10 to September 15, while nymphs had been collected between June 10 and July 17. It has been reported for the state by Rehn (147), Hendrickson (71), Knutson and Jaques (86), and Knutson (85).

Fremont, Lyon, Mills, Monona, Muscatine, Plymouth, Pottawattamie, Sioux, and Woodbury counties.

Genus Syrbula Stal

1873 Syrbula Stal, Recensio Orthop. p. 90.

Head almost or fully as long as pronotum; vertex subtriangular, distinctly surpassing eyes and rounded apically; antennae filiform in female, slightly clubbed in male; pronotum distinctly tricarinate, cut slightly be-

hind middle by principal sulcus, lateral lobes almost vertical and about as high as long; tegmina well developed, equalling or surpassing apex of abdomen; hind legs long and slender, femora surpassing apices of tegmina; sexes very unequal in size, male much smaller and more slender.

Genotype: Syrbula leucocerca Stal.

Two species are known from the United States, one of them occurring in Iowa.

Syrbula admirabilis (Uhler)

1864 Stenobothrus admirabilis Uhler, Proc. Ent. Soc. Phila. 2:553.

Male brown to dark brown with longitudinal yellowish markings on head, thorax and costal area of tegmina; inner face of antennal club blackened; tegmina brown, irregularly hyaline along a broad costal stripe; hind femora pale, banded on both outer and inner faces with fuscous; knees black. Female larger and more robust, with head, thorax, and tegmina in large part green marked with fuscous or black; legs usually and under parts yellowed; hind femora not banded. Length of body, males, 22-27 mm.; females, 35-40 mm. (Fig. 13).

The present species occupies the southeastern part of the United States as far north and west as Maryland, Illinois, Nebraska, and Texas. It is an inhabitant of dry fields and closely cropped roadsides where the soil is poor and the plants generally sparse. Occasional specimens have been found in sparse woods and orchards.

July 3 and October 3 mark the extreme of dates that were present on adult specimens studied. The species was previously listed for the state by Knutson and Jaques (86) and Knutson (85).

Appanoose, Boone, Cedar, Clarke, Davis, Decatur, Delaware, Des Moines, Dickinson, Dubuque, Fremont, Henry, Iowa, Jasper, Jefferson, Johnson, Keokuk, Lee, Linn, Louisa, Marion, Muscatine, Page, Polk, Ringgold, Story, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, and Woodbury counties.

Genus Amphitornus McNeill

1897 Amphitornus McNeill, Proc. Davenport Acad. Nat. Sci. 6:179.

Head horizontal, face strongly receding, juncture of face and vertex broadly angulately rounded; fastigium feebly concave either side of short, low, median carina; frontal costa wide, shallowly sulcate around and above ocellus, slightly divergent below; pronotum low, slightly tectate, median carina distinct and cut just behind middle by principal sulcus, hind margin slightly rounded; lateral pronotal carinae absent, but supplemental carinae sometimes developed along either side of median one; tegmina and wings fully developed, surpassing apex of abdomen; hind femora exceeding apex of abdomen; hind tibiae with 12-13 spines on outer upper margin.

Genotype: Stenobothrus coloradus Thomas.

The single species of this genus has been collected in Iowa.

Amphitornus coloradus coloradus (Thomas)

1873 Stenobothrus coloradus Thomas, Rept. U.S. Geol. Surv. Terr. 5:82.

1940 Amphitornus coloradus King, Proc. Iowa Acad. Sci. 46:417.

Brownish-yellow above, frequently with a mid-dorsal pale stripe which extends from apex of head to hind margin of pronotum and sometimes to tip of tegmina; narrow postocular stripe from eye back across lateral lobe, another running from eye along lower margins of lateral lobe onto costal area of tegmina; knees of hind legs black. Length of body, 17-22 mm.

The range of this species appears to be highly discontinuous but to encompass the area from Manitoba to British Columbia in southern Canada south into the United States to Illinois, Iowa, Kansas, Colorado, Utah, and Washington. It is known to frequent dry grassy country within the above area.

King (80) reported taking a single female in Dickinson County on August 5, 1938. That specimen, made available for study by the kindness of Dr. King, was the only local individual seen during the preparation of this paper.

Genus Eritettix Bruner

1890 Eritettix Bruner, Proc. U.S. Nat. Mus. 12:56.

Vertex produced anteriorly in front of eyes, disk medianly tricarinate, outer carinae frequently feeble; frontal costa prominent, widened downward, slightly constricted near median ocellus; pronotum short, obtusely angled posteriorly, disk with median and lateral carinae calloused and distinct, sometimes also with a pair of supplementary carinae, one either side of median one, all cut behind the middle by principal sulcus; tegmina and wings reaching or surpassing apex of abdomen.

Genotype: Eritettix variabilis Bruner.

A single species shows two races in Iowa.

Eritettix simplex (Scudder)

1869 Gomphocerus simplex Scudder, Trans. Am. Ent. Soc. 2:305.

Color light brown, antennae paler basally, dorsum of head and pronotum usually infusate with brown or black and with a broad pale median line delimited laterally by the supplementary carinae (latter absent or very faint when pale stripe is absent); in females the ground color of brown is frequently replaced with green on head, upper half of lateral lobes of pronotum, mesopleurae, a broad subcostal stripe on basal half of tegmina and upper outer face of hind femora; tibial spines broadly tipped with black. Length of body, males, 15-17 mm.; females 21-25 mm.

The general range of this species is quite extensive within the United States; it extends from Connecticut south to Georgia and west to Wyoming and Colorado. It is usually to be encountered on treeless, sparsely weeded areas where it may occur in some numbers. The species breaks into two races, an eastern and a western one, both of which are found among local material. These two races or subspecies may be separated by the following couplet:

Key to the Subspecies of Eritettix simplex in Iowa

1. Lateral carinae of pronotum distinctly, but moderately angulately constricted in front of middle . . . E. simplex tricarinatus p. 210

Lateral carinae of pronotum straight, subparallel, not constricted E. simplex simplex p. 210

Eritettix simplex simplex (Scudder)

- 1869 Gomphocerus simplex Scudder, Trans. Am. Ent. Soc. 2:305.
 1928 Eritettix simplex Hendrickson, Ann. Ent. Soc. Am. 31:133
 1930 Eritettix simplex Hendrickson, Iowa State Coll. Jour. Sci. 4:58.
 1934 Eritettix (!) simplex Hendrickson, Proc. Iowa Acad. Sci. 40:238.

This, the typical race, is sufficiently characterized by the general description of the species plus the shape of the lateral pronotal carinae as given in the key to the subspecies. It occupies the southeastern part of the species' range from Connecticut south to Georgia west to Illinois, Iowa, Oklahoma, and Texas.

Adult material of this subspecies was most abundant for the season from May 9 to July 12 while a few specimens bore September labels. Local listing for this race was given by Knutson and Jaques (86) and Knutson (85).

Buchanan, Dickinson, Emmet, Fremont, Lyon, Plymouth, Sioux, Story, and Woodbury counties.

Eritettix simplex tricarinatus (Thomas)

- 1873 Stenobothrus tricarinatus Thomas, Rept. U. S. Geol. Surv. Terr. 5:84.
 1877 Stenobothris tricarinatus Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.
 1892 Stenobothris tricarinatus Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1897 Eritettix tricarinatus McNeill, Proc. Davenport Acad. Nat. Sci. 6:219.
 1897 Eritettix tricarinatus Ball, Proc. Iowa Acad. Sci. 4:238.
 1910 Eritettix tricarinatus Kirby, Synon. Catal. Orth. 3:111.
 1925 Eritettix tricarinatus Hebrad, Proc. Acad. Nat. Sci. Phila. 77:53.
 1928 Eritettix tricarinatus Hebard, Ibid. 80:226.
 1931 Eritettix tricarinatus Hebard, Ibid. 83:140.

This race was first described as a valid species and then reduced to its present status by Hebard (63). The following quotation indicates the nearness of these two races: "In tricarinatus the most evident difference lies in the usually lesser thickening of the antennal apices and the more distinct as well as more abrupt constriction of the lateral carinae of the pronotum.

Subspecies E. s. tricarinatus occupies the western, drier part of the species range and is known to occur in Minnesota, Iowa, Nebraska, both Dakotas, Colorado, and Wyoming.

In Iowa collections, this race is commonly represented but appears to intergrade with the nominal form in degree of angulation of pronotal carinae and thickening of the antennal apex. However, this is to be expected since this state lies along the region of contact between the two races. Nymphal specimens were not uncommon in the material studied; they embraced the period from February 4 to September 26. Since even some of the earliest ones were already halfway through their development, the as-

sumption may be safely made that this species hibernates as partly grown nymphs. The earliest adult date was for April 24 and the latest for September 11, but judging from the extensive period of occurrence of nymphs the adults probably are to be found until the early killing frosts of autumn. Additional literature records of this subspecies for the state were given by Knutson and Jaques (86) and Knutson (85).

Hamilton, Plymouth, Story, and Woodbury counties.

Genus Phlibostroma Scudder

1875 Phlibostroma Scudder, Proc. Boston Soc. Nat. Hist. 17:516.

Face only slightly receding downward; vertex ascending anteriorly, with or without indications of faint median carina; eyes small, shorter than height of subocular suture; pronotum, and consequently lateral carinae, strongly constricted medially, hind margin distinctly produced, obtusely angled to broadly rounded; tegmina and wings variable in length - shorter than, equal to or longer than abdomen; hind tibiae with inner apical spurs moderately unequal.

Genotype: Stenobothrus quadrimaculatus Thomas.

The lone North American species of the genus has been collected in Iowa.

Phlibostroma quadrimaculatum (Thomas)

1871 Stenobothrus quadrimaculatus Thomas, Prelim. Rept. U. S. Geol. Surv. Wyo. and Terr. 2:280

Color yellowish-brown to green, marked with yellow and dark brown, most diagnostic markings being a broad postocular stripe and four or five large, irregular blotches on median area tegmina; hind femora at least faintly banded; hind tibiae yellow to orange-pink, spines tipped with black. Length of body, 17.5-28 mm.

The general range of this grasshopper extends from Manitoba, North Dakota, Iowa, Kansas, and Oklahoma west to Alberta, Wyoming, Colorado, and New Mexico south into old Mexico.

All Iowa specimens had been collected in the westernmost tier of counties during August. Knutson (85) reported it from the state.

Fremont, Harrison, Plymouth, and Sioux counties.

Genus Orphulella Giglio-Tos

1894 Orphulella Giglio-Tos, Boll. Mus. Torino. 9:10.

Head horizontal, face moderately receding; vertex horizontal, lateral foveolae usually distinct triangular impressions; frontal costa high, flat, weakly sulcate near ocellus; pronotum with median and lateral carinae distinct, cut at or slightly behind middle, lateral carinae coarctate; hind margin broadly subangulate or rounded; tegmina usually reaching or surpassing apex of abdomen; hind femora exceeding tip of abdomen; hind tibiae with 10-12 spines on outer margin.

Genotype: Acrydium punctatum DeGeer.

Of the four species of the genus reported by Gurney (40) for the United States only two have been found in Iowa.

Key to the Species of Orphulella¹ in Iowa

1. Fastigium (from above) obtuse, dorsal impression little developed and near to and usually paralleling margins of fastigium (Fig. 45); apices of tegmina seldom surpassing tips of hind femora O. speciosa p. 212
- Fastigium (from above) rectangular to acute, dorsal impression well developed and distinctly removed from margins of fastigium (Fig. 44); apices of tegmina sometimes distinctly surpassing tips of hind femora O. pelidna pelidna p. 213

Orphulella speciosa (Scudder)

- 1862 Stenobothrus speciosus Scudder, Boston Jour. Nat. Hist. 7:458.
 1892 Stenobothrus aequalis Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1897 Orphula speciosa Ball, Proc. Iowa Acad. Sci. 4:238.

Color variable, may be brown with fuscous or black markings on prothorax and tegmina, or brown with head, pronotum and tegmina in large part green with regular fuscous or black marking present; pronotum with or without velvety black spots on disk, lateral carinae sometimes pale; vertex with lateral margins distinctly raised; pronotum with lateral carinae usually incurved, median carina cut near or behind middle by principal sulcus; tegmina of male usually without spurious vein in median area, in female, ulnar vein usually curving anteriorly; tip of dorsal valve of aedeagus in lateral view shaped as in Fig. 61; lateral basivalvular sclerite of lower valve of ovipositor almost always colorless. Length of body, 13-21 mm.

The range of this species extends from Maine south to North Carolina and west to Manitoba, Montana, Colorado, and Texas. It occurs most abundantly on sandy soils and short grass fields and pastures.

Adults of this very common species appear first about July 17 and are found from then until frost. Drake and Decker (23) reported O. speciosa as a serious pest of bluegrass pastures in western Iowa during the grasshopper outbreak of the middle 1930's. Other literature reports of this species in the state were given by Scudder (140), Hebard (51), Hendrickson (70, 71), Knutson and Jaques (86), Knutson (85), and Gurney (40).

Adams, Appanoose, Audubon, Black Hawk, Boone, Buchanan, Buena Vista, Calhoun, Carroll, Cass, Cherokee, Clarke, Clayton, Clinton, Davis, Decatur, Delaware, Des Moines, Dickinson, Emmet, Floyd, Fremont, Hamilton, Hancock, Harrison, Henry, Humboldt, Johnson, Keokuk, Kossuth, Lee, Louisa, Lyon, Madison, Mahaska, Marion, Mills, Muscatine, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Sac, Sioux, Story, Taylor, Union, Van Buren, Warren, Washington, Wayne, Winnebago, Winneshiek, Woodbury, and Wright counties.

¹Gurney (40) pointed out that these two species are not always reliably separated on external characters. In doubtful cases reference should be made to the shape of the tip of the dorsal valve of the aedeagus as illustrated for each species.

Orphulella pelidna pelidna (Burmeister)

1838 Gomphocerus pelidnus Burmeister, Handb. Ent., 2:650.

1897 Orphula pelidna McNeill, Proc. Davenport Acad. Nat. Sci. 6:238.

Very similar to congener O. speciosa and not always separable therefrom by external characters although those given in key will work in the majority of specimens; reliable determination of all may be had by recourse to the tips of the upper valves of the aedeagus of the male as shown in Fig. 62, or by observing the fuscous color on the base of the lateral basivalvular sclerite of the ovipositor in the female. Length of body, 14.5–24 mm.

The general range of this eastern race of the species is from the Atlantic States south of Massachusetts westward to Alberta, Montana, Kansas, and New Mexico where it intergrades with the western race. The present race frequents moister, long grass areas, but appears to occur only locally this far north.

This species is much less common in the state than is O. speciosa. The small series of specimens available had been collected during July, August, and October. The only state record found in literature was given by Gurney (40).

Decatur, Henry, Keokuk, and Sioux counties.

Genus Dichromorpha Morse

1896 Dichromorpha Morse, Psyche, 7:326.

Vertex shorter than broad, margins strongly elevated, median carina absent; frontal costa sulcate, constricted above bases of antennae; pronotum with disk flat, the three prominent carinae straight, parallel, cut behind middle by principal sulcus; lateral lobes perpendicular, converging downward; tegmina and wings rarely reaching beyond middle of abdomen; lower apical spurs of hind tibiae equal.

Genotype: Chloealtis viridis Scudder.

One species of the genus occurs in Iowa.

Dichromorpha viridis (Scudder)

1862 Chloealtis viridis Scudder, Boston Jour. Nat. Hist. 7:455.

1877 Chrysochraon viridis Bessey, 7th Bienn. Rept. Ia. State Coll. p. 207.

1877 Chrysochraon punctatum Bessey, Ibid. p. 207.

1892 Chrysochraon viridis Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Dicromorpha (!) viridis Ball, Proc. Iowa Acad. Sci. 4:238.

Color in both sexes dimorphic: males either wholly brown with face and legs paler, or brown with face yellowish and dorsal surface of head, pronotum, tegmina, and middle legs distinctly greenish; females either wholly brown with fuscous spots on pronotum and tegmina, or nearly wholly green with a fuscous to black line extending from hind margin of eye back along lateral carinae of pronotum; on both sexes hind tibiae yellowish with black spot at bases of long whitish hairs, these sometimes obsolete apically; normally with tegmina and wings strongly abbreviated, rarely with them fully developed. Length of body, males, 15–17 mm.; females, 23–27 mm.

The range of D. viridis extends from New Hampshire west to South Dakota and south and southwest to Florida, Oklahoma, and Texas. It frequents open woods and densely grown fields, hedgerows and roadsides.

Among the nearly 200 Iowa specimens examined, seven females showed fully developed tegmina and wings. Adult records extended from June 24 to September 16. Literature records, other than those cited above, were given by Ball (2), Hebard (51), Hendrickson (71), Knutson and Jaques (86), and Knutson (85).

Audubon, Boone, Cass, Cedar, Chickasaw, Clay, Clayton, Davis, Delaware, Des Moines, Dickinson, Emmet, Fremont, Greene, Hamilton, Henry, Howard, Iowa, Jasper, Johnson, Keokuk, Lee, Linn, Louisa, Lyon, Marion, Mills, Mitchell, Monona, Muscatine, Osceola, Page, Palo Alto, Polk, Poweshiek, Sioux, Story, Taylor, Van Buren, Webster, Woodbury, and Worth counties.

Genus Chloealtis Harris

1841 Chloealtis Harris, Rept. Ins. Mass. Inj. Veget. p. 148.

Head slightly ascending; vertex with sides distinctly elevated, median carina very short but evident; pronotum with three longitudinal carinae cut behind middle by principal sulcus; lateral lobes vertical, front and hind margins converging downward; tegmina nearly or quite reaching apex of abdomen in males and but slightly surpassing middle of abdomen (rarely fully developed) in females; hind tibiae with inner apical spurs subequal.

Genotype: Locusta (Chloealtis) conspersa Harris.

The only species of the genus is known to occur in Iowa.

Chloealtis conspersa Harris

1841 Locusta (Chloealtis) conspersa Harris, Rept. Ins. Mass. Inj. Veget. p. 149.

1877 Chrysochraon conspersum Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.

1892 Chrysochraon conspersum Osborn, Proc. Iowa Acad. Sci. 1(2):118.

Male brown to light brown above, always with lateral lobes of pronotum shining black; abdomen blackish above and on sides basally; tegmina with elongate black spot along middle of costa, apical area not or vaguely spotted; hind femora faintly barred with fuscous on outer face, underside usually reddish; hind tibiae reddish or yellowish. Female wholly brown with numerous conspicuous fuscous spots on tegmina; hind tibiae colored as in male. Length of body, 15-28 mm.

This grasshopper is known to range from Maine into Ontario and Alberta in southern Canada and south to North Carolina, Arkansas, and Colorado. It appears to prefer denser vegetative cover such as is furnished by woods and grown-up fence rows.

Adult specimen records were available for the period between June 14 and September 16. Knutson (85) wrote that, locally, "This species seems to favor sparsely wooded areas and has been observed depositing eggs in decaying wood." Other state listings were given by Ball (2), Somes (145, 146), Hebard (57), Knutson and Jaques (86), and Knutson (85).

Boone, Cedar, Clayton, Delaware, Dickinson, Emmet, Franklin, Fremont, Hancock, Henry, Iowa, Jackson, Johnson, Keokuk, Linn, Louisa, Lyon, Monona, Muscatine, Page, Polk, Sioux, Story, and Webster counties.

Genus Chorthippus Fieber

1852 Chorthippus Fieber, Kelch, Orthop; Oberschles. p. 1.

Vertex triangular; frontal costa wide, sulcate only around and below ocellus; pronotum tricarinate, median one higher, all cut behind middle by principal sulcus; lateral lobes about as broad as deep, hind margin more strongly oblique; tegmina variable in length, usually fully developed in males, wings always slightly shorter; hind femora elongate, slender.

Genotype: Acrydium albomarginatum DeGeer.

The lone North American species occurs in Iowa.

Chorthippus longicornis (Latreille)

1804 Acrydium longicorne Latreille, Hist. Nat. Crust. Ins., 12:159.

1877 Stenobothris curtipennis Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.

1891 Chloealtis curtipennis Osborn and Gossard, Iowa Exp. Sta. Bull. No. 15, p. 267.

1892 Stenobothris curtipennis Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Stenobothrus curtipennis McNeill, Proc. Dav. Acad. Nat. Sci. 6:262.

1897 Stenobothris curitpennis Ball, Proc. Iowa Acad. Sci. 4:239.

1899 Stenobothris curtipennis Scudder, Proc. Am. Acad. Arts Sci. 35:50.

1930 Chorthippus curtipennis Hendrickson, Iowa State Coll. J. Sci. 4:59.

Color variable, usually brown or yellowish-brown, paler beneath, with distinct postocular stripe extending back across upper half of lateral lobe of pronotum; sides of abdomen and knees strongly marked with deep black; sometimes any or all following parts washed with light green; head, lateral lobes of pronotum, and hind femora; vertex often with faint trace of median carina; pronotum tricarinate, lateral carinae constricted anteriorly; hind margin of pronotum obtusely angled or rounded; tegmina transparent to hyaline, veins opaque, darker, costal area distinctly fenestrate in males. Length of body, 13-24 mm.

In North American literature this species has long gone under the name of C. curtipennis (Harris), but Hebard (63) showed this to be a synonym of C. longicornis. C. longicornis is a holarctic species whose range includes Europe, Asia, and North America; on the latter continent it inhabits the region from Alaska southeast and south to New Jersey, Iowa, and Colorado, and thence southward in the two mountain ranges to South Carolina and New Mexico. It is reported most commonly from grasslands, especially in low wet prairies and meadows.

Available adult specimens had been collected between July 2 and September 11. State listings, in addition to those cited above, have been given by Hebard (57, 63), Knutson and Jaques (86), and Knutson (85). Hendrickson (71) noted it as "most numerous at Andropogon furcata consocieties."

Boone, Bremer, Buena Vista, Clay, Delaware, Dickinson, Davis, Emmet, Greene, Hancock, Humboldt, Johnson, Kossuth, Lyon, O'Brien, Osceola, Palo Alto, Story, Union, Webster, and Winnebago counties.

Genus Aeropedellus Hebard

1935 Aeropedellus Hebard, Ent. News 46:186.

Lateral foveolae strongly impressed; pronotum with lateral carinae moderately to strongly constricted, hind margin obtusely, angulately produced; tegmina with costa strongly lobate near base, in males strongly fenestrate; tegmina abbreviated, more strongly so in females.

Genotype: Gomphocerus clavatus Thomas.

One of the two North American species has been found in Iowa.

Aeropedellus clavatus (Thomas)

1873 Gomphocerus clavatus Thomas, Rept. U.S. Geol. Surv. Terr. 5:96.

1928 Gomphocerus clavatus Hebard, Proc. Acad. Nat. Sci. Phila. 80:229.

1931 Gomphocerus clavatus Hebard, Proc. Acad. Nat. Sci. Phila. 83:142.

Color light brown, antennae (except enlarged apex) and face yellow; tegmina immaculate, fenestrate for most of length in male; abdomen with large dark patch on base of each segment laterally; hind femora with faint fuscous cloudings on outer face; hind tibiae yellow; pronotum widest anteriorly, tricarinate dorsally; lateral carinae strongly angulately constricted anterior to middle; prozona distinctly longer than metazona, latter with hind margin rounded; tegmina of male usually reaching above supra-anal plate, sometimes surpassing apex of abdomen, of female much shorter. Length of body, 19-28 mm.

The range of this species extends from Alaska south through British Columbia to Arizona and east to Manitoba, Minnesota, Iowa, Nebraska, and New Mexico. Throughout its ranges, this grasshopper occurs locally and sometimes abundantly on dry, grassy uplands.

The lone Iowa specimen available for study was an old one in the Iowa State College collection. It had been collected at Little Rock, Lyon County, July 2, 1897. However, Hebard (55, 61) twice listed Greene County material with the comment that that record marked a southeastern limital point in its range. These records indicate that it should occur in suitable habitats in at least the northwestern quarter of the state.

Genus Stethophyma Fischer

1853 Stethophyma Fischer, Orthop. Europe, p. 297.

Head horizontal, vertex short with interrupted median carina; foveolae small, triangular; face receding; pronotum with median carina prominent, cut at or slightly behind middle by principal sulcus; hind margin obtusely angled; lateral lobes as high as long, lower margin ascending on anterior half; tegmina and wings fully developed, almost or quite reaching apex of abdomen; male tegmina with stridulating rasp on intercalary vein; hind femora at least reaching apex of abdomen and red below.

Genotype: Gryllus (Locusta) grossus Linnaeus.¹

Three species of the genus belong to the Iowa fauna.

¹Vide Roberts (128).

Key to the Species of Stethophyma in Iowa

1. Prozona shorter than metazona; lateral carinae distinctly diverging on latter 2
 Prozona and metazona subequal in length; lateral carinae at most vaguely divergent on metazona; tegmina without pale subcostal stripe S. platypterum p. 218
2. Tegmina with pale subcostal stripe extending two-thirds its length S. lineatum p. 217
 Tegmina without pale subcostal stripe S. gracile p. 217

Stethophyma lineatum (Scudder)

- 1862 Arcyptera lineata Scudder, Boston Jour. Nat. Hist. 7:462.
 1891 Arcyptera lineata McNeill, Psyche 6:66.
 1897 Mecostethus lineatus McNeill, Proc. Davenport Acad. Nat. Sci. 6:254.
 1897 Mecostithus (!) lineatus Ball, Proc. Iowa Acad. Sci. 4:239.
 1914 Mecostethus lineatus Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141. p. 26.
 1915 Mecostethus lineatus Somes, 15th Rept. St. Ent. Minn. p. 26.

Color purplish-brown with yellow stripe extending from upper margin of eye back along lateral carinae of pronotum; prozona and metazona rugose; tegmina dusky, hyaline on apical half; hind femora yellow on outer face, apices black; hind tibiae bright yellow except for black base and spines. Length of body, males 23-27 mm.; females, 34-38 mm.

This bog-inhabitant is known to occur from Nova Scotia west to Manitoba and south to New Jersey, Indiana, Illinois, Iowa, and Nebraska.

The only Iowa material studied had been collected by R.L. King between July 22 and August 18. The specimen reported by Ball (2) was not in the Iowa State College collection. Several additional Iowa listings were given by Blatchley (8), Hebard (55, 57, 59, 63), Knutson and Jaques (86), and Knutson (85).

Dickinson, Emmet, and Scott counties.

Stethophyma gracile (Scudder)

- 1862 Arcyptera gracilis Scudder, Boston Jour. Nat. Hist. 7:463.

Color pale brown, head and pronotum obsoletely marked with yellow stripes from above eyes back along lateral carinae of pronotum; tegmina uniformly brown; hind legs black at knees, tibiae yellow with sub-basal pale ring; pronotal disk rugose; tegmina not reaching apex of abdomen in female. Length of body, males, 19-23 mm.; females, 26-33 mm.

This more northern species occurs across southern Canada as far west as Alberta and south into the United States to Maine, Michigan, and Nebraska. It is said to frequent moist meadows and fields along streams.

Adult and nymphal material collected between July 15 and August 23 by King (and now in his collection) furnished basis for the present report as well as those that were given by Knutson and Jaques (86) and Knutson (85).

Clay and Dickinson counties.

Stethophyma platypterus (Scudder)

1862 Arcyptera platyptera Scudder, Boston Jour. Nat. Hist. 7:463.

1897 Mecostithus (!) platypterus Ball, Proc. Iowa Acad. Sci. 4:239.

1915 Mecostethus platypterus Somes, 15th Rept. St. Ent. Minn. p. 28.

Dark reddish-brown, head and pronotum obsoletely marked with yellow stripes from upper margin of eyes back along lateral carinae of pronotum; pronotum rugose on metazona only. Length of body, males 23-26 mm.; females, 35-40 mm.

Massachusetts, Connecticut, South Carolina, Illinois, Iowa, and Minnesota have yielded specimens of this species. It is known to frequent swamps and moist fields.

The Iowa records given by Ball (2), Somes (145), Blatchley (8), and Hebard (51) were based on a specimen from a meadow at Little Rock, Lyon County. Although representatives of most of the material of Ball's list maybe found in the Iowa State College collection, the above mentioned specimen was not present at the time of this study. No local material was seen during the preparation of this paper.

Genus Ageneotettix McNeill

1897 Ageneotettix McNeill, Psyche 8:71.

Vertex slightly declivent, deeply impressed discally, median carina absent, prominent marginal carinae meeting at almost a right angle; frontal costa feebly divergent downward, slightly sulcate at median ocellus; pronotum with median carina prominent, lateral carinae obsolete or absent; except behind principal sulcus which cuts median carina behind middle; hind margin of pronotum broadly rounded or obtusely angled; lateral lobes deeper than long, front and hind margins parallel, lower margin strongly ascending anteriorly; tegmina slightly shorter than, equal to or surpassing apex of abdomen, wings as long as tegmina; hind femora stout, surpassing apex of abdomen.

Genotype: Chrysochraon deorum Scudder.

One race of the lone North American species occurs abundantly within the state.

Ageneotettix deorum deorum (Scudder)

1876 Chrysochraon deorum Scudder, Bull. U.S. Geol. Surv. Terr. 2:262.

1897 Eremis seuderi (!) Ball, Proc. Iowa Acad. Sci. 4:239.

1930 Ageneotettix deorum Hendrickson, Iowa State Coll. Jour. Sci. 4:59.

General color mottled brown, yellowish below; many specimens showing pale medio-dorsal stripe from apex of head to tip of tegmina; pronotum with strongly constricted lateral carinae usually marked by pale line which is margined medially and laterally by black; hind femora with three more-or-less distinct crossbars on upper and outer faces, apices broadly polished black; hind tibiae red with whitish ring distad of black base. Length of body, 10-22 mm.

This grasshopper ranges from Indiana north and west to Manitoba and Saskatchewan, Montana, Kansas, Texas, and New Mexico. It occurs on sandy soils with sparse vegetative cover.

Locally it has been found in some abundance in sandy or sparsely grown fields and roadsides. It was reported "at all Andropogon scoparius-Bouteloua curtipendula association stations" by Hendrickson (loc. cit.) in his prairie studies. Knutson and Jaques (86) and Knutson (85) also gave records for the state. Adults have been collected from June 24 until October 10.

Adams, Audubon, Boone, Bremer, Buena Vista, Cass, Cedar, Cherokee, Clarke, Clay, Crawford, Dallas, Decatur, Dickinson, Emmet, Fremont, Hancock, Harrison, Henry, Ida, Iowa, Johnson, Linn, Lucas, Lyon, Madison, Mahaska, Mills, Muscatine, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Ringgold, Sac, Shelby, Sioux, Story, Taylor, Union, Van Buren, Warren, Wayne, Washington, Webster, and Woodbury counties.

Genus Boopedon Thomas

1870 Boopedon Thomas, Proc. Acad. Nat. Sci. Phila. 1870, p. 83.

Head wider than thorax, occiput convex, vertex declivent with faint median carina; frontal costa prominent, flat; pronotum with sides parallel, subtruncated anterior margin, obtusely angled posterior margin; median carina distinct, not elevated, cut near or behind middle by principal sulcus, lateral carinae obsolete to distinct; tegmina variable, reaching halfway or all the way to tip of abdomen; hind femora surpassing apex of abdomen.

Genotype: Gryllus nubilus Say.

The important papers on this genus were by Caudell (18) and Hebard (53, 58). A single species occurs in Iowa.

Boopedon auriventris McNeill

1899 Boopedon auriventris McNeill, Canadian Ent. 31:54.

1897 Boopedon nubilum Ball, Proc. Iowa Acad. Sci. 4:239.

1925 Boopedon nubilum Hebard, Proc. Acad. Nat. Sci. Phila. 77:63.

1928 Boopedon nubilum Hebard, Proc. Acad. Nat. Sci. Phila. 80:231.

1936 Boopedon nubilum Hebard, N.D. Agr. Exp. Sta. Bull. No. 284. p. 34.

Color brown to grayish-brown; lateral lobes of pronotum with prominent line along front margin and broader, submarginal band paralleling hind margin yellowish-white; hind femora more or less banded with fuscous; hind tibiae pale before vague, premedian fuscous ring, reddish beyond; pronotum with lateral carinae obsolete to absent, median carina cut distinctly behind middle by principal sulcus; tegmina abbreviated, represented by oval pads with sharply rounded apices; hind femora long, slender, hind tibiae with 13-15 spurs on outer upper edge. Length of body, 21-34 mm.

The range of this grasshopper seems quite limited on the basis of published records; it occurs from Nebraska and Iowa south and southwest to Arkansas and Texas.

In 1897, two years before the description of B. auriventris, Ball listed B. nubilum from the state without locality but with the notation, "Rare. Two specimens taken in July, 1894." Subsequent comments on the local occurrence of B. nubilum by Hebard (loc. cit.) were apparently based on

Ball's published record. However, one specimen bearing Ball's name as collector was found in the collection of Iowa State College. Upon examination it proved to be B. auriventris and not B. nubilum, and has so been labelled at an earlier date by R.L. King. The specimen is labelled as coming from Ames, but in view of its absence from the many student collections which are made every year in the vicinity of Ames and the fact that all other labelled specimens had been collected only in the southwesternmost county of the state, that locality record is definitely open to question.

All specimens, other than the one mentioned above, were collected in Fremont County during the month of August. There this species occurs on the loess river bluffs in grassy clearings among the trees, usually on or near the tops of the hills. A published record from the same locality under the present name was given by Knutson (85).

Genus Aulocara Scudder

1876 Aulocara Scudder, Bull. United States Geol. Surv. Terr. 2:266.

Vertex ascending anteriorly, without median carina; frontal costa regularly widening downward, flattened to strongly sulcate; pronotum distinctly strangulate; lateral carinae obsolete or absent, strongly incurved medially then more widely divergent posteriorly; prozona longer than metazona; tegmina and wings subequal, usually not attaining apex of abdomen; last abdominal sternite of female with shallow rounded emargination either side of middle of apical margin.

Genotype: Stauronotus elliotti Thomas.

The single species of the genus has been found in Iowa.

Aulocara elliotti (Thomas)

1870 Stauronotus elliotti Thomas, Proc. Acad. Nat. Sci. Phila. p. 182.

Color brownish, head darker above; disk of pronotum and spots on tegmina fuscous; site of lateral carinae of pronotum and sutural margins of tegmina usually whitish; hind femora with three black bands across upper surface, these at least partly invading both outer and inner surfaces, underside sometimes marked with blue; hind tibiae blue or yellow. Length of body, males, 14.5-17 mm.; females, 21-24 mm.

The general range of the "big-headed grasshopper" extends from Manitoba south through Minnesota, Iowa, Kansas, Oklahoma, and Texas into Mexico, and west to British Columbia and the Pacific coastal states. It is a grasslands species, but occurs most abundantly in the short-grass prairies farther west.

Specimen and literature records indicated that the season for this species in Iowa is between July 28 and August 13, but this appears to be too short if we judge from the season of other local species. Previous listings for the state were given by Knutson (85) and Pfadt (102). The latter also gives a discussion of the food and distribution of this species.

Dickinson, Mills, Plymouth, and Sioux counties.

Subfamily OEDIPODENAE Walker

1870 OEDIPODINAE Walker, Catal. Dermaptera British Mus. 4:721.

Antennae filiform, usually inserted above middle of eyes; eyes rarely longer than height of gena below them; pronotum widest across lateral angles, surface generally wrinkled or tuberculate; lateral carinae weak or absent; median carina low or crested, but to varying depths by one or two transverse sulci; tegmina and wings fully developed, latter generally with basal half or more strongly and brightly colored and bordered by a distinct fuscous, subapical crossband.

Although certain members are to be found along sandy beaches, as a group these insects prefer much drier situations than those frequented by the Acridinae. They may be found in woods, weedy fields or open, dusty, sun-baked paths and roads. They fly readily and while in flight most species are made very conspicuous by their brightly colored hind wings. Several theories as to the purpose of these gaudy markings have been proposed. One idea, suggested by Vosseler (149), is that the bright colors shown by the insect during flight contrast so strongly with the sombre colors displayed while at rest on the ground that they dazzle or confuse a pursuer and so prevent detection when the grasshopper alights on the ground. Morse (94), however, pointed out that the flashing of the brilliant colors in flight was accompanied by a strong crackling sound and suggested that the two taken together served as a means of "communication between the sexes or the individuals of a community." To anyone who has attempted to capture specimens the theory of Vosseler seems more appropriate. But the fact that these grasshoppers behave the same way even when apparently undisturbed lends weight to the plausibility of Morse's ideas.

A number of explanations have been given for the crackling sounds made by these insects when in flight. Fulton (30) concluded, after a series of experiments in which he removed the wings in part or entirely, that "Apparently the louder sounds are produced by striking the wings and tegmina against each other during flight." The work of Isely (75) did not agree with this. He found that simple crushing of the large longitudinal veins of the hind wing prevented the insect from making the sound. From his experiments, Isely concluded "that the tegmina are unnecessary to flight noises," and that the crackling sound resulted from the slackening and sudden tightening of the membrane between the stiff veins of the hind wing. Such contradictory results need to be resolved by additional experimentation; or, as suggested by Gurney (MS.), perhaps species differ in this mechanism. Several species are also capable of sounding a different call while at rest. This results from rubbing the inner surface of the hind femur against certain roughened veins on the tegmen.

Although most species pass the winter in the egg stage, a few endure this season as young nymphs.

Apparently the only American effort to produce a key to all genera of this subfamily known to occur in North America was that of Scudder (137); the section of the subfamily dealing with Trimerotropis and allied genera has more recently been revised by Gurney (39).

Of the approximately forty named North American genera, fourteen have been collected in Iowa.

Key to the Genera of OEDIPODINAE in Iowa

1. Median carina of pronotum entire or cut by but one sulcus
(Figs. 47 and 48) 2
Median carina of pronotum cut by two sulci, part between them
lobate or otherwise modified 10
2. Median carina of pronotum elevated, entire or weakly nicked by
principal sulcus 3
Median carina of pronotum either elevated or low, always strongly
cut by principal sulcus (Fig. 47) 4
3. Hind wing with disk opaque, brightly colored and with a distinct
fuscous or black, curved, subapical band Arphia p. 223
Hind wing with disk transparent, faintly yellowed, without a
distinct subapical black crossband Chortophaga p. 226
4. Hind wing black with yellow or hyaline border . . Dissosteira p. 233
Hind wing not black with yellow border 5
5. Disk of metazona smooth or punctured, not rugose or tuberculate 6
Disk or metazona with a strong, shining rugae and tubercles . . 9
6. Pro- and metazona both with distinct, calloused lateral carinae
. Camnula p. 229
Prozona without calloused lateral carinae 7
7. Hind tibiae blue to black with sub-basal white ring
. Encoptolophus p. 227
Hind tibiae at least in part orange to reddish 8
8. Prozona tectate with median carina elevated; metazona smooth
or vaguely punctured; inner face of hind femora not blue-black
on basal two-thirds Spharagemon p. 235
Prozona transversely convex; median carina of pronotum low,
thread-like throughout; inner face on hind femora blue-black
on basal two-thirds Hadrotettix p. 237
9. Prozona as long as metazona Hippiscus p. 229
Prozona distinctly shorter than metazona . . . Pardalophora p. 230
10. Antennae simple, cylindrical; wing disk not reddish . . . 11
Antennae flattened and broadened basally; wing disk pink to
reddish (in Iowa material) Psinidia p. 242
11. Meta-, meso-, and prozona arranged step-like up to the elevated
vertex; vertex without transverse carina between eyes . . 13
Pronotum not elevated step-like anteriorly 12
12. Metazona with strong, shining rugae and tubercles; median
carina between two intersecting sulci modified or obsolete
. Xanthippus p. 233
Metazona not or only faintly rugose or tuberculate; median
carina of pronotum uniformly prominent throughout its length
. Trimerotropis p. 237
13. Inner face of hind femora bluish, without preapical black
crossband; size larger, length of body at least 23 mm.
in male and 28 mm. in female Metator p. 242
Inner face of hind femora black on basal half or more, usually
with a separate black crossband at apical fourth; size smaller,
length of body not over 20 mm. in male and 26 mm. in female.
. Trachyrachis p. 240

Genus Arphia Stal

1873 Arphia Stal, Recensio Orthop., 1:113.

Vertex horizontal, distinctly concave discally, median carina usually present; foveolae large but shallow; pronotum anteriorly bluntly angled over base of head, posteriorly more strongly and acutely produced; median carina compressed, tectate to cristate; tegmina leathery, opaque, distinctly reticulate, more transparent and with larger cells on apical third.

Genotype: Gryllus sulphureus Fabricius.

Some of the nominal species of this genus are very difficult to separate and may eventually be combined, but by generally accepted diagnostic characters five species are known to occur in the state.

Key to the species of Arphia in Iowa

1. Frontal costa not noticeably narrowed above, nearly parallel-sided to to junction with vertex, there more than half as wide as just below ocellus 2
Frontal costa strongly narrowed above to junction with vertex, there less than half as wide as just below ocellus 3
2. Median carina of pronotum strongly elevated, cristate, strongly arched longitudinally (Fig. 48); fuscous crossband of hind wing sending subcostal spur about one-third of distance to base A. xanthoptera p. 223
Median carina of pronotum elevated but not cristate, not or only faintly arched longitudinally; fuscous crossband of hind wing sending subcostal spur more than halfway to base A. pseudonietana pseudonietana p. 225
3. Impressed area of vertex longer than broad, its lateral carinae (when viewed from side) declivent anteriorly and making vertex meet frontal costa at not more than a faint, obtuse angle . . . 4
Impressed area of vertex at least as broad as long, its lateral carinae (when viewed from side) horizontal or slightly ascending anteriorly and making vertex meet frontal costa at a distinct angle A. sulphurea p. 225
4. Subcostal spur of fuscous crossband on hind wing remote from costal margin so that pale colored area in front of it is at least twice as wide as the fuscous spur . . . A. simplex p. 225
Subcostal spur of fuscous crossband of hind wing close to costal margin so that pale colored area in front of it is narrower than the fuscous spur A. conspersa p. 224

Arphia xanthoptera (Burmeister)

- 1838 Oedipoda xanthoptera Burmeister, Handb. Ent., 2:643
1869 Oedipoda carinata Scudder, Trans. Am. Ent. Soc. 2:306.
1879 Tomonotus carinatus Thomas, Rept. U.S. Geol. Surv. Terr. 5:106.
1877 Tomonotus carinatus Bessey, 7th Bienn. Rept. Ia. State Coll. p. 207.
1877 Tomonotus xanthopterus Bessey, Ibid. p. 207.
1883 Tomonotus carinatus Bruner, Rept. U.S. Ent. Comm. 3:56.
1884 Arphia carinata Saussure, Prodrom. Oedipod. p. 67.

1892 Tomonotus carinatus Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Arphia carinata Ball, Proc. Iowa Acad. Sci. 4:239.

Color dark brown to pale rusty brown, head and pronotum usually lighter than tegmina, latter often obscurely mottled with fuscous; hind wings with basal two-thirds deep yellow or orange-red; hind femora faintly obliquely fasciate externally; knees blackish; hind tibiae blackish with prominent sub-basal whitish or yellowish ring, sometimes beyond middle with broad glaucous area; fastigium broadly rounded or subtruncate anteriorly. Length of body, 21-34 mm.

The United States east from South Dakota, Nebraska, Kansas, Oklahoma, and Texas is included in the range of A. xanthoptera. This grasshopper is an inhabitant of dry, untilled land but may occur in woods or fields.

Scudder (loc. cit.) described the synonymous Oedipoda carinata from Iowa. The adults of this species appear in summer and fall; extremes of Iowa dates on material studied were July 20 and October 30 with the majority of specimens collected in September and October. Other notations of the local occurrence of this form were given under the present name by Ball (2), Somes (144, 145), Hebard (51, 55), Knutson and Jaques (86), and Knutson (85).

Appanoose, Clarke, Davis, Decatur, Des Moines, Fayette, Fremont, Henry, Jefferson, Lee, Louisa, Muscatine, Page, Polk, Plymouth, Ringgold, Story, Taylor, Van Buren, and Warren counties.

Arphia conspersa Scudder

1875 Arphia conspersa Scudder, Proc. Boston Soc. Nat. Hist. 17:514.

1914 Arphia arcta Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 37.

1915 Arphia arcta Somes, 15th Rept. St. Ent. Minn. p. 37.

1925 Arphia frigida Hebard, Proc. Acad. Nat. Sci. Phila. 77:70.

Brown to grayish-brown, yellowed below; tegmina frequently mottled with fuscous; hind wings basally yellow (in all local specimens examined) through orange to pink; hind tibiae with area beyond sub-basal pale ring almost entirely yellowish or glaucous. Length of body, 19-28 mm.

The range of this species as indicated in literature extends from Alaska south to British Columbia and thence south in the Rocky Mountains to New Mexico and Arizona, and eastward in southern Canada and the United States to Manitoba, Minnesota, Iowa, Kansas, and Texas. This form frequents grasslands.

With the exception of a series labelled for Ames during May and June, 1897, all specimens of this species were taken in the western third of the state. The Ames series was probably mislabelled; after noting many of the Ames records for that year and the lack of later collections for many of the species anywhere near Ames, one is forced to conclude that labels already printed were used for material from nearly any part of the state. This is a spring and early summer form, adult dates were for the period from May 11 to June 17. The species was noted for the state by Osborn (98), Ball (2), Scudder (143), Knutson and Jaques (86), and Knutson (85).

Adams, Dickinson, Fremont, Mills, Page, Plymouth, Taylor, and Woodbury counties.

Arphia pseudonietana pseudonietana (Thomas)

1870 Tomonotus pseudo-nietana Thomas. Proc. Acad. Nat. Sci. Phila. p. 82.

1892 Arphia tenebrosa Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1930 Arphia pseudonietana Hendrickson, Ia. State Coll. Jour. Sci. 4:59.

Color extremely variable from nearly black (in some males) to pale grayish-brown with numerous fuscous flecks and spots resulting in a decidedly mottled appearance; dorsum of pronotum frequently in large part or entirely yellow or light gray; hind wings rich pink or salmon basally. Length of body, males, 19-24 mm.; females 27-33 mm.

This species is known from British Columbia south to New Mexico and Texas and east to Ontario, Michigan, Iowa, Nebraska, Kansas, and Oklahoma. The preferred habitat is a dry, sparsely weeded area, especially on sandy or gravelly hills.

The numerous adults in local collections indicated this species to be rather common between July 17 through October 9. It was reported for the state by Hebard (51, 53), Knutson and Jaques (86), and Knutson (85).

Carroll, Clay, Dickinson, Johnson, Kossuth, Lyon, Osceola, Palo Alto, Plymouth, Sioux, Story, Woodbury, and Worth counties.

Arphia simplex Scudder

1875 Arphia simplex Scudder, Proc. Boston Soc. Nat. Hist. 17:514.

Color above very dark brown, lower half of face ashen, tegmina variously mottled with darker spots and blotches; hind wing yellow through orange to deep pink at base; hind femora vaguely trifasciate externally; pronotum with median carina low, not markedly arched longitudinally. Length of body, 25-39 mm.

This species has been reported as occurring from South Dakota south through Nebraska, Kansas, Oklahoma, and Texas into Mexico. It is now known to occur in Iowa.

This species appears to occur locally only in the western edge of the state. Adult specimens had been taken between June 1 and August 20. Knutson and Jaques (86), and Knutson (85) have also reported it for the state.

Dickinson, Fremont, and Sioux counties.

Arphia sulphurea (Fabricius)

1781 Gryllus sulphureus Fabricius, Spec. Ins. 1:369.

1892 Tomonotus sulphureus Osborn, Proc. Iowa Acad. Sci. 1(2):118.

Color blackish-brown to pale reddish-brown, paler below and sometimes also on dorsal area of tegmina; tegmina frequently with scattered fuscous dots of varying distinctness; hind tibiae blackish beyond sub-basal whitish ring, frequently pale glaucous beyond middle; basal part of hind wing yellow; median carina of pronotum low, not strongly arched longitudinally. Length of body, males, 17-22 mm.; females, 26-30 mm.

This species ranges widely east of the great plains from southern Canada south to Florida and west to Iowa, Missouri, Oklahoma, and Texas. It is most often found in dry fields and pastures or along roadsides.

A. sulphurea is a spring and early summer form for which available records of adults extended from May 2 until August 26. It sometimes occurs along with A. xanthoptera during July and early August but gives way to that species as fall approaches. Other state reports were given by Ball (2), Hebard (51, 55), Knutson and Jaques (86), and Knutson (85).

Adair, Appanoose, Boone, Buena Vista, Cedar, Davis, Delaware, Des Moines, Franklin, Fremont, Henry, Iowa, Jackson, Jefferson, Johnson, Linn, Louisa, Madison, Muscatine, Plymouth, Sioux, Story, Taylor, Van Buren, Wapello, Warren, and Webster counties.

Genus Chortophaga Saussure

1884 Chortophaga Saussure, Mem. Soc. Phys. et Nat. de Geneve, 28(9):72.

Vertex horizontal, sides and truncated front margin carinate, median carina absent; frontal costa prominent, sulcate below ocellus, somewhat narrowed above bases of antennae; pronotum strongly tectate, front margin bluntly angled, hind margin acutely angled; median carina usually weakly cut just in front of middle by principal sulcus; lateral carinae present on metazona only; tegmina distinctly surpassing apex of abdomen, apical half membranous; wings faintly yellowed basally, with vague faint subapical crossband; hind femora reaching or surpassing tip of abdomen.

Genotype: Acrydium viridifasciatum DeGeer.

One of the two species of the genus occurs abundantly in Iowa.

Chortophaga viridifasciata (DeGeer)

1773 Acrydium viridifasciatum DeGeer, Mem. Hist. Nat. Ins., 3:498.

1867 Tragocephala viridifasciata Thomas, Proc. Davenport Acad. Nat. Sci. 1:253.

1873 Tragocephala viridifasciata Thomas, Rept. U.S. Geol. Surv. Terr. 5:103.

1877 Tragocephala infuscata Bessey, 7th Bienn. Rept. Ia. State Coll. p.207.

1877 Tragocephala viridifasciata Bessey, Ibid. p. 207.

1892 Tragocephala viridifasciata Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1892 Tragocephala infuscata Osborn, Ibid. 1(2):118.

Color dimorphic: from largely green with a longitudinal area of brown on upper part of tegmina to entirely brown; hind tibiae tan to brown, always with a pale, sub-basal annulus; pronotum punctate to finely tuberculate. Length of body, 17-22 mm.

The "green meadow grasshopper" is widely distributed in the eastern two-thirds of North America ranging from southern Canada to Florida and west to Saskatchewan, Colorado, and Texas. Although these insects may be found in woods, dry fields, or wet meadows, their habitat preference appears to be for higher, better drained lands along woodland borders or in open woods.

The color variation mentioned in the description may be found in either sex. Of the more than 700 Iowa specimens checked, the brown males outnumbered the green males, 329 to 26, and the green females appeared about twice as numerous as the brown females, 232 to 117. The nymphs, too, show this color difference, but not enough were available to give a significant proportion.

In Iowa this is one of the few grasshoppers which hibernates as a nymph, the smaller instars being active whenever warm days occur during the winter. With renewed feeding and growth in spring, these individuals quickly reach adulthood; earliest specimen-records were for April 20. Somes (144, 145) recorded collecting adults in Iowa as early as March 1. Surely, this is not the usual time in so northern a clime. The other extreme of dates is for mid-October. The common occurrence of this species in the state is attested to by the numerous literature reports given above and following: Ball (2), Somes (144, 145), Hendrickson (70, 71), Knutson and Jaques (86), and Knutson (85).

Adams, Allamakee, Appanoose, Boone, Buena Vista, Cass, Cedar, Clarke, Clayton, Clinton, Davis, Decatur, Delaware, Des Moines, Dickinson, Emmet, Franklin, Fremont, Guthrie, Hamilton, Hancock, Henry, Humboldt, Iowa, Jasper, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Mahaska, Marion, Marshall, Mills, Monroe, Montgomery, Muscatine, Page, Palo Alto, Polk, Pottawattamie, Poweshiek, Scott, Story, Taylor, Union, Van Buren, Washington, Wayne, Webster, and Woodbury counties.

Genus Encoptolophus Scudder

1875 Encoptolophus Scudder, Proc. Boston Soc. Nat. Hist. 17:478.

Vertex triangular, depressed anteriorly, disk deeply concave; foveolae distinct, elongate and triangular; frontal costa narrow, deeply sulcate throughout in male, above ocellus only in female; prozona sub-equal in length to and slightly higher than metazona, latter flat, feebly rugose; tegmina distinctly surpassing apex of abdomen; their tips rounded or obliquely truncated.

Genotype: Oedipoda sordida Burmeister.

Encoptolophus sordidus (Burmeister)

1838 Oedipoda sordida Burmeister, Handb. Ent. 2:643.

Color yellowish- or grayish-brown, mottled and marked with fuscous; pronotal disk frequently with X-shaped pale mark; tegmina appearing blackened with two distinct crossbars in middle third and sometimes apex pale; wings yellowish-hyaline at base, washed with fuscous apically; hind femora with upper and usually outer face rather distinctly banded, inner basal half or more blackened; hind tibiae brown or glaucous beyond sub-basal pale ring; pronotum with median carina distinct, notched near middle by principal sulcus. Length of body, 18-29 mm.

The general range of the species extends from New England south to North Carolina and west to Alberta, North Dakota, Kansas, and Texas. It usually frequents sunny, treeless tracts or areas. It breaks into an eastern and western race, the common borders of which include western Iowa. These two subspecies may be recognized by the following key:

Key to the Subspecies of Encoptolophus sordidus in Iowa

1. Head swollen, usually much wider than front edge of prothorax;
pronotal disk tectate, usually distinctly rugose or tuberculate,

lateral carinae strongly interrupted and dislocated in front of principal sulcus (Fig. 47). E. sordidus sordidus p. 228
 Head not much wider than front edge of prothorax; pronotal disk nearly flat, neither rugose nor tuberculate, lateral carinae only slightly dislocated in front of principal sulcus
 E. sordidus costalis p. 228

Encoptolophus sordidus sordidus (Burmeister)

- 1838 Oedipoda sordida Burmeister, Handb. Ent. 2:643.
 1875 Encoptolophus sordidus Scudder, Proc. Boston Soc. Nat. Hist. 17:479.
 1877 Oedipoda sordida Bessey, 7th Bienn. Rept. Ia. State Coll. p. 208.
 1892 Encoptolophus sordida Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1897 Encoptolophus sordidus Ball, Proc. Iowa Acad. Sci. 4:239.
 1928 Encoptolophus sordidus Hendrickson, Ann. Ent. Soc. Am. 31:133.
 1930 Encoptolophus sordidus Hendrickson, Ia. State Coll. Jour. Sci. 4:59.

Median carina of pronotum cristate, usually higher on more strongly tectate prozona; tegmina not polished; hind wing infusate on apical half, with both anterior axillary and anal veins blackened; hind tibiae beyond sub-basal pale ring typically fuscous, occasionally glaucous. Length of body, males, 18–21.5 mm.; females, 23–29 mm.

This is the eastern race of the species and occupies the territory from New England west to Minnesota, Nebraska, and Kansas and south to North Carolina, Tennessee, and Missouri. It usually frequents weedy fields.

Over most of the state this race occurs commonly and typically, but to the west it shows tendencies toward E. sordidus costalis. However, these specimens were still closer to the eastern subspecies and were so arranged here. Adults have been collected for the period from July 25 to October 29. Iowa listings have also been published by Knutson and Jaques (86) and Knutson (85).

Adams, Audubon, Boone, Calhoun, Cass, Clarke, Crawford, Davis, Decatur, Des Moines, Dickinson, Emmet, Franklin, Fremont, Harrison, Henry, Humboldt, Ida, Iowa, Jasper, Jefferson, Johnson, Kossuth, Lee, Louisa, Lyon, Lucas, Mahaska, Monona, Montgomery, Muscatine, Page, Palo Alto, Plymouth, Polk, Ringgold, Sac, Sioux, Story, Taylor, Union, Van Buren, Warren, Washington, Webster, and Winnebago counties.

Encoptolophus sordidus costalis (Scudder)

- 1862 Oedipoda costalis Scudder, Boston Jour. Nat. Hist. 7:473.

Pronotum with median carina distinct, low, of equal height throughout, disk flattened; tegmina polished; hind wings with apical third infusate, anal vein pale; hind tibiae beyond sub-basal pale ring usually glaucous. Length of body, males, 18–19.5 mm.; females, 21–24.5 mm.

The western subspecies occurs from Manitoba, Saskatchewan and Alberta in southern Canada south into North Dakota, Nebraska, Kansas, and Texas. It appears to prefer open grassy lands.

None of the material studied appeared to compare favorably with specimens of typical E. sordidus costalis from North Dakota and other western localities. However, Knutson and Jaques (86) and Knutson (85) listed the subspecies for three counties which are given below.

Dickinson, Lyon, and Sioux counties.

Genus Camnula Stal

1873 Camnula Stal, Recension Orthop. 1:114.

Vertex longer than broad, declivent anteriorly, lateral carinae low but distinct, median carina obsolete; pronotum with three nearly percurrent carinae, lateral ones not interrupted by principal sulcus which cuts median one distinctly in front of middle; tegmina surpassing apex of abdomen, apical cells longer and quadrate; hind femora reaching or surpassing apex of abdomen, their upper margin strongly elevated carina.

Genotype: Oedipoda pellucida Scudder.

The lone species of the genus has been taken in Iowa.

Camnula pellucida (Scudder)

1862 Oedipoda pellucida Scudder, Boston Jour. Nat. Hist. 7:472.

General color light to dark brown, face and underside lighter; dark markings variable in intensity and extent; tegmina usually with darker maculae on median area and dorsally dark with pale outer edge forming two posteriorly converging stripes; wings transparent, nervures black; hind femora unicolorous or with dark crossbars on either or both the upper and outer faces; hind tibiae yellowish, sometimes slightly darkened apically; lateral carinae of pronotum conspicuously diverging from just behind anterior margin, evanescent just before posterior margin. Length of body, 17-25 mm.

The general range of the "clear-winged grasshopper" is northern, but extends all the way across the continent. East of the Mississippi River it reaches south to Virginia and northern Illinois and Indiana, while west of that stream its range extends south through Nebraska into New Mexico and California.

Available specimen records, which were reported in part by Knutson and Jaques (86) and Knutson (85), are all from the northwestern corner of the state. They had been collected between July 24 and August 20.

Dickinson and Lyon counties.

Genus Hippiscus Saussure

1861 Hippiscus Saussure, Rev. et Mat. Zool., ser. 2. 13:398.

Head large, subglobose, genae swollen and strongly rounded into face; vertex sloping, median carina extending from apex back over occiput, with a subtransverse carina forming two triangular, depressed areas above the lateral foveolae; frontal costa broad, flat, margins almost parallel to junction with vertex; pronotum distinctly constricted at apical third, lateral carinae incomplete, not or only vaguely cut by principal sulcus; disk, at least of metazona, with polished, longitudinal rugae; hind margin right-angled; tegmina, wings and hind femora surpassing apex of abdomen; tegmina with numerous dark blotches; outer apical spines of hind tibiae much shorter than those on inner apex.

Genotype: Oedipoda (Hippiscus) ocelota Saussure.

Of the two species of this group, only one occurs in Iowa.

Hippiscus rugosus¹ (Scudder)

1862 Oedipoda rugosus Scudder, Boston Jour. Nat. Hist. 7:469.

1877 Oedipoda rugosa Bessey, 7th Bienn. Rept. Iowa State Coll. p. 208.

1897 Hippiscus variegatus Ball, Proc. Iowa Acad. Sci. 4:239.

Grayish-brown, variously marked with dark brown, face usually lighter; lateral margin of dorsal area of tegmina and frequently X-shaped mark on pronotal disk yellowish, rarely reddish; tegmina gray with numerous large fuscous blotches, those toward apex much broken; wings with basal part weakly to strongly colored yellow to pink, subapical fuscous crossbar with subcostal spur reaching over halfway to base; hind femora yellowish, inner and ventral surfaces with broad basal area and subapical crossband bluish-black, upper surface usually and outer face occasionally fasciate with black; hind tibiae yellowish. Length of body, males, 28-36 mm.; females, 37-42 mm.

The general range of this species was stated in inclusive terms by Scudder (1899) as "U.S. east of rocky Mts." It frequents drier upland fields and pastures.

Adult records from the state indicated the span of adult occurrence to be from July 20 to October 26. Locally the yellow-winged individuals outnumbered the red-winged ones about seven to one. Other literature listings of the species for the state were given by Somes (144, 145), Knutson and Jaques (86), and Knutson (85).

Appanoose, Cedar, Clarke, Davis, Decatur, Des Moines, Dickinson, Fremont, Harrison, Henry, Jasper, Johnson, Keokuk, Lee, Louisa, Lyon, Monona, Page, Plymouth, Polk, Ringgold, Sioux, Story, Taylor, Van Buren, Wapello, Warren, Washington, Wayne, and Woodbury counties.

Genus Pardalophora Saussure

1884 Oedipoda (Pardalophora) Saussure, Mem. Soc. Phys. et Nat. de Geneve, 28(9):83.

Very similar to Hippiscus and originally proposed as a subgenus thereof. However, the absence of the transverse carina on the vertex, the constriction of the frontal costa above the bases of the antennae and the longer metazona offer characters which, though admittedly rather weak, may be used to separate the two. Hebard (53), in his discussion of "The Group Hippisci," included among others, Iowa's three genera Hippiscus, Pardalophora, and Xanthippus and contended that they are distinct. The species P. haldemanii which had been variously treated under the two last named genera was considered to occupy a somewhat intermediate position but was assigned to Pardalophora because the median pronotal carina is cut by but one sulcus.

Genotype: Oedipoda phoenicoptera Burmeister.

¹Hebard (69) used H. ocelota Saussure for eastern specimens, but without comment. This may have been a lapsus, or it may have indicated that he thought H. rugosus was not a valid species. Commenting on the latter possibility, Gurney (MS.) quoted J. A. G. Rehn as being unconvinced on such synonymy.

Key to the Species of Pardalophora in Iowa

1. Basal half of median area of tegmina with a large, continuous dark blotch (Fig. 11) P. apiculata p. 231
 Basal half of median area of tegmina with several well-separated dark blotches 2
2. Inner face of hind femora uniformly buff or pink; tubercles of metazona uniting to form oblique ridges which tend to parallel the hind margin P. haldemanii p. 232
 Inner face of hind femora banded with black, the basal half of two-thirds chiefly bluish P. phoenicoptera p. 231

Pardalophora apiculata (Harris)

- 1835 Locusta apiculata Harris, in Hitchcock, Rept. Geol. Mass. 2nd Ed. p. 576.
 1897 Hippiscus tuberculatus Ball, Proc. Iowa Acad. Sci. 4:239.
 1914 Hippiscus tuberculatus Simes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141. p. 48.
 1915 Hippiscus tuberculatus Simes, 15th Rept. St. Ent. Minn. p. 48.
 1928 Hippiscus apiculatus Hendrickson, Ann. Ent. Soc. Am. 31:133.
 1930 Hippiscus apiculatus Hendrickson, Iowa State Coll. Jour. Sci. 4:60.
 1937 Paradophora (!) apiculata Knutson, Field and Lab. 5:44.

Color ash-brown to gray, lighter below. pronotum marked on lateral lobes with short dark bar and dorsally sometimes with indistinct longitudinal pattern; tegmina with base of median area as in key, apical third usually bearing well-separated fuscous blotches of irregular sizes and shapes; these may spread and fuse; hind femora vaguely trifasciate externally, inner surface with basal half and broad subapical crossband black; hind tibiae yellow, sometimes tinged with orange; basal disk of wing coral red (in all Iowa specimens studied), crossed on apical third by arcuate fuscous band which sends broad costal spur to base; pronotal disk almost flat, polished tubercles small, some of them longitudinally elongate. Length of body, males, 25-30 mm.; females, 36-44 mm. (Fig. 11).

The range of P. apiculata includes the area from Hudson Bay region south to North Carolina, Virginia, Missouri, and Kansas and west from the Atlantic coast to Alberta, Wyoming, and Montana. It inhabits sparsely weeded, sandy soil pastures, and roadsides.

Extremes of adult occurrence as indicated by specimen records are from April 23 until July 21, with one male specimen bearing a label for August 27. These early season records reflect the habit of at least some of the individuals which over-winter as partially grown nymphs. This species was also reported from the state by Knutson and Jaques (86).

Appanoose, Boone, Cedar, Davis, Delaware, Des Moines, Fremont, Henry, Jefferson, Johnson, Linn, Louisa, Lyon, Monroe, Muscatine, Sioux, Story, Union, Van Buren, Wapello, Wayne, and Woodbury counties.

Pardalophora phoenicoptera (Burmeister)

- 1838 Oedipoda phoenicoptera Burmeister, Handb. Ent. 2:643.
 1876 Oedipoda phoenicoptera Putnam, Proc. Dav. Acad. Nat. Sci. 1:266.

1892 Hippiscus phoenicopterus Osborn, Proc. Iowa Acad. Sci. 1(2):118.

Color ashy or reddish-brown with fuscous tegminal maculations, face and underside paler; tegminal markings small and much broken; hind wings reddish at base, arcuate apical crossband present and sending a subcostal spur almost to base; hind femora as in key, vaguely trifasciate on upper outer face; hind tibiae yellow, sometimes tinged with orange; disk of pronotum with numerous polished tubercles, when tubercles unite to form ridges these paralleling median carina. Length of body, males, 31-33 mm.; females, 42-45 mm.

The present species is known to range from New Jersey west to Kansas and south and southwest to Florida, Oklahoma, and Texas. It frequents bare ground in fields and open woods.

The above two listings probably represent misidentifications of P. apiculatus, that error being common during the late 1800's. No local specimens or recent reports of Iowa occurrence were available. However, the known range of the species indicates that the form should be found within the state's borders.

Pardalophora haldemanii (Scudder)

1872 Oedipoda haldemanii Scudder, U.S. Geol. Surv. Neb., Final Rept., p. 251.

1877 Oedipoda haldemanii Bessey, 7th Bienn. Rept. Iowa State College, p. 208.

1892 Hippiscus haldemanii Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Hippiscus haldemanii Ball, Proc. Iowa Acad. Sci. 4:239.

1914 Hippiscus tigrinus Somes, Univ. Minn. Agr. Exp. Sta., Tech. Bull. No. 141, p. 46.

1915 Hippiscus tigrinus Somes, 15th Rept. St. Ent. Minn. p. 46.

1930 Hippiscus haldemanii Hendrickson, Iowa State Coll. Jour. Sci. 4:60.

Color ashen to brownish-gray, paler below; pronotal and tegminal maculations similar to those described for P. apiculata but smaller and more numerous and ulnar area with a series of separated spots; hind wings yellow or reddish at base, inner costal spur of arcuate crossband not quite reaching base; hind femora with outer and upper faces vaguely trifasciate, inner and lower faces unicolorous; hind tibiae yellow through orange to reddish; polished tubercles of metazona variable in number, tending to form ridges parallel to hind margin. Length of body, males, 27-35 mm.; females, 42-46 mm.

The recorded range is from Indiana west to Colorado and south to southern Illinois and Kansas. The insect is usually found on dry soils which support relatively sparse grass and other scrubby vegetation.

Available local specimens had been collected between June 4 and August 18. State listings of this grasshopper had also been given by Hebard (51, 53), Knutson and Jaques (86), and Knutson (85).

Adair, Audubon, Buena Vista, Clarke, Davis, Delaware, Dickinson, Fremont, Greene, Harrison, Johnson, Keokuk, Linn, Lucas, Lyon, Madison, Mills, Monona, Montgomery, Muscatine, Osceola, Page, Plymouth, Pottawattamie, Sac, Sioux, Story, Union, and Woodbury counties.

Genus Xanthippus Saussure

1884 Xanthippus Saussure, Mem. Soc. Phys. et Nat. de Geneve. 28(9):46.

This genus is very suggestive of Hippiscus and Pardalophora and was at one time considered a subgenus of the former (see discussion under Pardalophora). Vertex declivent anteriorly, disk depressed with more or less distinct median carina; frontal costa constricted above bases of antennae, strongly sulcate around and below ocellus; pronotal disk rugose or tuberculate or both, median carina low, cut distinctly in front of middle by two sulci with the carina between them depressed, deformed or obliterated; pronotal hind margin acutely angled; tegmina and wings surpassing apex of abdomen.

Genotype: Oedipoda corallipes Haldeman.

Iowa's only member of this genus is the northernmost race of a western species.

Xanthippus corallipes latefasciatus(Scudder)

1892 Hippiscus (Xanthippus) latefasciatus Scudder, Psyche 6:359.

1892 Hippiscus (Xanthippus) zapotecus Scudder, Psyche 6:319.

1897 Hippiscus (Xanthippus) zanotecus (!) Ball, Proc. Iowa Acad. Sci. 4: 239.

1900 Hippiscus (Xanthippus) zapotecus Scudder, Proc. Davenport Acad. Nat. Sci. 8:35.

1914 Hippiscus zapotecus Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 51.

1915 Hippiscus zapotecus Somes, 15th Rept. St. Ent. Minn., p. 49.

Color reddish-brown, paler on face and below; tegmina boldly maculate, darker markings on ulnar area tending to form transverse blotches; hind wings yellow basally, arcuate fuscous crossband present; hind femora with three slightly oblique, somewhat broken crossbands, inner and lower faces strongly washed with red; hind tibiae equally red but whitish externally on basal half or more. Length of body, 29.5-44 mm.

The subspecies X. corallipes latefasciatus, an inhabitant of the northern Great Plains, extends its range from Manitoba to Alberta in southern Canada south to Montana, Wyoming, and Colorado and eastward in the sand areas of Nebraska and Minnesota to the western banks of the Mississippi River.

The general range indicates that even though no local specimens were available for study the above-mentioned early records based on a specimen bearing the data "Denison (Crawford County), July 15th; J. A. Allen" are to be accepted.

Genus Dissosteira Scudder

1876 Dissosteira Scudder, Ann. Rept. Chief of Engineers for 1876, Append. JJ, p. 511.

Vertex declivent anteriorly, disk sub-pentagonal or ovate, median and lateral carinae low; frontal costa sulcate, slightly narrowed above and below ocellus; pronotum tectate anteriorly, more flattened on metazona, median carina high, cristate, deeply cut by principal sulcus in front of middle and strongly arched on metazona; lateral carinae rounded, obsolete

on prozona; hind margin right-angled; tegmina and wings distinctly surpassing apex of abdomen; wings black with marginal pale band; hind femora not surpassing apex of abdomen.

Genotype: Gryllus carolinus Linnaeus.

Two species have been taken in Iowa; one is a permanent member of the local fauna while the other represents eastward migrations of strong-flying individuals and not an established population.

Key to the Species of Dissosteira in Iowa

1. Tegmina unicolorous or with obscure fuscous speckling; hind wings with marginal pale band opaque yellow, black area extending all the way to base D. carolina p. 234
- Tegmina with distinct fuscous blotchings; hind wing with marginal pale band transparent, hyaline, black area distinctly fading out before reaching base D. longipennis p. 235

Dissosteira carolina (Linnaeus)

1758 Gryllus locusta carolinus Linnaeus, Syst. Nat. Edit. X. 1:433.

1868 Oedipoda carolina Walsh and Riley, Am. Ent. 1:52.

1876 Oedipoda carolina Putnam, Proc. Davenport Acad. Nat. Sci. 1:266.

1877 Oedipoda carolina Bessey, 7th Bienn. Rept. Ia. State Coll. p. 208.

Color variable from light gray through reddish-brown to dark brown with or without obscure fuscous mottlings; tegmina and wings as in key, former translucent on apical third; hind femora faintly annulate, paler subapically and with three broad black bands on inner face; hind tibiae yellow or dusky. Length of body, 24-40 mm.

The range of the "Carolina grasshopper" is one of the most extensive of any North American grasshopper. As Scudder (142) noted, it occurs in the "United States and Canada from coast to coast." The adults usually frequent hard-packed, sun-baked surfaces such as paths, roads and occasionally open, cultivated fields.

This is probably one of the most "civilized" grasshoppers. From early July until well into late fall it occurs almost as commonly on sidewalks and streets of sizeable towns as it does on dusty rural roads. In both places it is made conspicuous by the flashing of its yellow-banded black wings during a hovering flight about two or three feet above the ground. The nymphs prefer a habitat of more dense and lush plant growth. The conspicuous abundance of this species in Iowa is readily attested to by the number of literature references to local occurrence by the authors cited above and in the following list: Osborn (98), Ball (2), Hendrickson (71), Knutson and Jaques (86), and Knutson (85).

Adair, Adams, Allamakee, Audubon, Black Hawk, Boone, Bremer, Buchanan, Buena Vista, Butler, Carroll, Cass, ~~Cerro~~ Gordo, Cherokee, Chickasaw, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson, Emmet, Floyd, Franklin, Fremont, Green, Hancock, Hardin, Harrison, Henry, Humboldt, Ida, Iowa, Jasper, Jefferson, Johnson, Keokuk, Kossuth, Lee, Louisa, Lyon, Madison, Mahaska, Marion, Marshall, Mills, Monona, Monroe, Montgomery, Muscatine, Osceola, Page, Palo Alto, Plymouth, Polk, Pottawattamie,

Ringgold, Sac, Scott, Shelby, Sioux, Story, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winnebago, Winneshiek, and Woodbury counties.

Dissosteira longipennis (Thomas)

1873 Oedipoda longipennis Thomas, Ann. Rept. U.S. Geol. Surv. Terr. Hayden, 5:463.

Color clay-yellow through brown, paler beneath; tegmina and wings as in key; hind femora showing faint oblique fuscous bands externally and with broad black crossbands on inner face; hind tibiae yellow. Length of body, males, 30-34 mm.; females, 38-44 mm.

The "long-winged plains grasshopper" is a native of the western Great Plains region from Colorado and Nebraska south to Texas and New Mexico. At times this strong-flying species becomes very restless and some individuals make long migratory flights.

Such long flights probably account for the Iowa record as given for Des Moines County by Knutson (85).

Genus Spharagemon Scudder

1875 Spharagemon Scudder, Proc. Boston Soc. Nat. Hist. 17:467.

Vertex narrowed, declivent anteriorly, disk shallowly concave, with or without faint median carina; frontal costa sulcate for most of length; pronotum tectate anteriorly, metazona flattened, median carina usually (not always) high, strongly compressed and deeply notched by principal sulcus, lateral carinae usually distinct on metazona only; tegmina and wings surpassing apex of abdomen; hind femora reaching or surpassing apex of abdomen.

Genotype: Gryllus aequalis Say.

This genus was revised by Morse (93) and subsequently discussed by Hebard (64). Three of the seven species are known to occur in Iowa.

Key to the Species of Spharagemon in Iowa

1. Hind tibiae distinctly red with a sub-basal pale ring followed by a premedian black ring S. bolli bolli p. 235
- Hind tibiae without premedian black ring 2
2. Median carina on metazona cristate, more or less longitudinally arched S. collare p. 236
- Median carina on metazona low, not at all elevated, not longitudinally arched S. equale p. 236

Spharagemon bolli bolli Scudder

1875 Spharagemon bolli Scudder, Proc. Boston Soc. Nat. Hist. 17:469.

Color variable from rusty brown through dark gray to fuscous, frequently with darker maculations which may take form of crossbars on tegmina and outer face of hind femora; hind wings greenish-yellow at base, median curved fuscous crossband broad, giving off short subcostal spur inwardly; pronotal disk very feebly rugose; median carina more cristate on prozona than on metazona, notch made by principal sulcus vertical. Length of body, 20-36 mm.

The known range of S. bolli bolli extends eastward from Manitoba, Colorado, Oklahoma, and Texas. It frequents the bare soil of paths, roadsides, slopes of hills, and cultivated fields.

In Iowa, adults appear early in July and have been found as late as October 16, indicating that they probably occur until frost. References to this species in the state were given by Scudder (133), McNeill (90), Morse, (93), Ball (2), Knutson and Jaques (86), and Knutson (85).

Boone, Bremer, Cass, Clayton, Davis, Delaware, Des Moines, Dickinson, Emmet, Fremont, Hancock, Harrison, Henry, Jefferson, Johnson, Lee, Muscatine, Plymouth, Story, Van Buren, Washington, and Woodbury counties.

Spharagemon collare (Scudder)

1872 Oedipoda collare Scudder, Geol. Surv. Nebr., Final Rept. pt. 3, p. 250.

1877 Oedipoda collaris Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.

1892 Sphaeragamon (!) collaris Osborn, Proc. Iowa Acad. Sci. 1(2):118.

Color variable, yellowish through brown to gray, extensively mottled with dark brown which may form more or less distinct crossbars on tegmina and outer face of hind femora; hind femora banded with black on inner face; red of hind tibiae frequently paler basally; hind wing with fuscous band broad, reaching hind angle and sending short subcostal spur toward base; pronotum distinctly cristate throughout; hind margin of prozona projecting backwards to overhang or cover oblique notch made by principal sulcus. Length of body, 19-30 mm.

This species ranges from Ontario south to Florida and west to Wyoming, Utah, and Arizona. It appears to inhabit open sandy areas.

Locally, adults have been collected not uncommonly from June 9 to October 18. The species was listed for Iowa by Scudder (133), Morse (93), Ball (2), Knutson and Jaques (86), and Knutson (85).

Boone, Cedar, Clarke, Clay, Crawford, Dallas, Dickinson, Fremont, Harrison, Jefferson, Johnson, Lyon, Monona, Muscatine, Osceola, Sioux, and Story counties.

Spharagemon aequale (Say)

1825 Gryllus aequalis Say, Jour. Acad. Nat. Sci. Phila. 4:307.

1874 Trimerotropis aequalis Scudder, Hitchcock Rept. Geol. N.H. 1:377.

1875 Spharagemon aequale Scudder, Ent. Notes, 4:67.

1875 Spharagemon aequale Scudder, Proc. Boston Soc. Nat. Hist. 17:468.

1877 Oedipoda aequalis Bessey, 7th Bienn. Rept. Iowa State Coll. p. 208.

1892 Sphaeragamon (!) aequalis Osborn, Proc. Iowa Acad. Sci. 1(2):118.

Color yellow, gray, or brown, strongly mottled with black or dark brown, this forming crossbars of varying distinctness on tegmina and outer face of hind femora; inner face of hind femora bright orange with black crossbars; hind wing yellowed at base, arcuate fuscous band sending subcostal spur almost halfway to base; prozona somewhat tectate, raising anterior part of median carina somewhat above that on metazona; hind angle of pronotum usually distinctly rounded. Length of body, males, 25 mm.; females, 27-33 mm.

The range extends from Minnesota through North Dakota and Alberta into British Columbia, south to Missouri, Oklahoma, Texas, and Utah. This grasshopper is to be found in grassy plains environments.

It was also listed for the state by Hebard (51, 53), Knutson and Jaques (86), and Knutson (85). Although Hebard (51) noted it as being "common in Iowa," relatively few specimens were seen during this study. They had all been collected during July and August.

Dickinson, Lyon, and Plymouth counties.

Genus Hadrotettix Scudder

1876 Hadrotettix Scudder, Ann. Rept. Chief Engineer for 1876, Append. JJ, p. 291.

Vertex declivent anteriorly, almost rounding into partly sulcate frontal costa; pronotum flattened, both transverse sulci cutting very low median carina well in advance of middle; metazona finely longitudinally to reticulately rugose, hind margin prominently rectangular or acute; lateral carinae absent; tegmina surpassing apex of abdomen; hind wing with radiate veins not abnormally swollen; hind femora attaining or surpassing tip of abdomen, upper and lower margins strongly keeled.

Genotype: Gryllus trifasciatus Say.

One species occurs locally.

Hadrotettix trifasciatus (Say)

1825 Gryllus trifasciatus Say, Am. Ent. 2:34.

Color light brown to clay yellow, tegmina with three strong, nearly or quite complete transverse black bands; antennae, except basal few segments, deep black; hind wing with fuscous crossband at least as wide as metazona, following hind border almost to anal angle, without subcostal spur directed toward base; hind femora on outer face with one oblique, postmedian black bar, inner face bluish-black with a broad, pale, subapical crossbar; hind tibiae yellowish to pinkish-orange, gradually paler basally, especially on outer face. Length of body, males 27-31 mm.; females 35-41 mm.

This species is known to range from South Dakota, Iowa, Missouri, Oklahoma, and Texas north and west to Saskatchewan, Montana, Colorado, and Arizona. It usually frequents rocky places or upland sand areas.

All Iowa specimens had been collected in the western part of the state between July 26 and August 27. The species has only thrice been reported for the state by Hendrickson (71), Knutson and Jaques (86), and by Knutson (85).

Dickinson, Lyon, Monona, Plymouth, Pottawattamie, Sioux, and Woodbury counties.

Genus Trimerotropis Stal

1873 Trimerotropis Stal, Recensio Orthop., 1:118.

Disk of vertex longer than broad, median carina faint or absent; frontal costa strongly sulcate on lower two-thirds or more; pronotum with disk nearly flat, either smooth or minutely tuberculate on metazona, latter

strongly broadened and wider than head; median carina low, both intercepting sulci occurring distinctly before middle; lateral carinae indistinct; tegmina and wings much exceeding apex of abdomen; hind femora reaching or surpassing apex of abdomen.

Genotype: Locusta maritima Harris.

Some fifty or more nominal species are currently recognized in the United States. Some of these are very closely related, if not identical, and the published records are much confused and unreliable. The genus is greatly in need of a critical revision (as indicated by letters from both Gurney and Rehn), but until it is so treated work must be based on existing literature, unsatisfactory as that may be. The latest complete treatment of the genus, by McNeill (91), is very unreliable in the light of partial but more recent studies. Iowa records are available for three species while the known distribution of a fourth indicates that it should also be found in the state.

Key to the Species and Subspecies of Trimerotropis in Iowa

1. Inner and lower faces of hind femora black with two narrow pale bands across apical half; hind tibiae yellowed.
 T. pallidipennis salina p. 239
- Inner and lower faces of hind femora pale with one or two narrow black bands 2
2. Lower surface of hind femora reddish with a single black band at apical fourth; hind tibiae reddish T. laticincta p. 239
- Lower surface of hind femora usually yellowish, with at least a weak second dark band near middle 3
- 3.¹ Generally brown finely tessellated with slightly darker areas.
 Form slightly more graceful. Caudal tibiae pink. T. citrina p. 239
- Generally brown with darker areas and whitish suffusions and flecking. Form slightly more robust. Caudal tibiae usually buff, sometimes pink. T. maritima interior p. 238

Trimerotropis maritima interior Walker

1898 Trimerotropis maritima interior Walker, Canadian Ent. 30:262.

Color light to dark gray or reddish-brown, mottled with fuscous; laterally and below often whitish; tegmina with scattered fuscous spots, these most abundant on basal third; wing disk yellow, subapical crossband not more than one-fifth length of wing; hind femora unmarked on outer face; hind tibiae yellow or tan, rarely pink or orange; frontal costa sulcate full length; median carina of pronotum low throughout; metazona about twice as long as prozona, hind margin obtusely angled. Length of body, 19-35 mm.

This race occurs from Ontario to Saskatchewan south to Indiana, Illinois, and Iowa. It is to be found in season on bare flat sandy areas along bodies of water.

Although no Iowa specimens were available for study, a literature

¹This couplet is copied from Hebard (59). For further comments see discussion under T. maritima interior.

record by Hebard (57) listed material for "Muscatine and Fort Dodge, Iowa; the former a southern, the latter a southeastern limit point." This species and the next appear to be very closely allied and difficult to separate except when the hind tibiae of the present form are yellow. The key couplet copied from Hebard (59) does not permit separation of all specimens. Typical specimens from Ontario were loaned by Gurney for study, but even these did not enable the author to reach any conclusions other than that these two forms are extremely close.

Trimerotropis citrina Scudder

1876 Trimerotropis citrina Scudder, Bull. U.S. Geol. Surv. Terr. 2:265.

Color gray or yellowish-brown, faintly sprinkled with fuscous; dark spots on tegmina arranged in broken but more or less distinct crossbars; wings yellow, subapical crossband about one-fourth as wide as length of wing, hind femora vaguely or not at all banded on outer face; hind tibiae pinkish, paler toward base; frontal costa feebly sulcate; pronotum with median carina low throughout; metazona little more than one-and-a-half times as long as prozona, hind margin obtusely angled with tip rounded. Length of body, male, 20-33 mm.; female, 28-32 mm.

General range extends from Pennsylvania to Florida and west to Nebraska, Kansas, Oklahoma, and Texas thence into New Mexico. This species is to be found most frequently on open sandy fields and pathways.

Adult records were for the period from July 1 to September 16. In literature, records were given by Ball (2), Knutson and Jaques (86), and Knutson (85).

Des Moines, Dickinson, Johnson, Lee, Louisa, Lucas, Muscatine, Van Buren, and Wapello counties.

Trimerotropis laticincta Saussure

1884 Trimerotropis laticincta Saussure, Prodr. Oedip. p. 169.

Color brownish with moderately distinct, broad bands on tegmina, apical one broken; wings with dark crossband about one-third as wide as length of wing and continuing almost to anal angle; vertex shallowly sulcate with distinct median carina; metazona with numerous vermiculate rugae tending to parallel very low median carina, usually also with several small, elongate, polished black tubercles. Length of body, 25-39 mm.

East of the Rocky Mountains this species is known to occur from Montana and South Dakota south to Oklahoma and Texas and east to Iowa and Kansas.

This species is included on the basis of the "more than a dozen specimens" reported by King (80) as having been collected in Lyon County on August 8, 1938. Dr. King said that they had been collected in a "gravel pit."

Trimerotropis pallidipennis salina McNeill

1900 Trimerotropis salina McNeill, Psyche 9:33.

Color dark brown, tegmina obscurely maculate with fuscous to form crossbands; wings slightly yellow, dark crossband median in position, its width about one-third length of the wing; hind femora not banded on outer

face; hind tibiae yellow to obscure fuscous; vertex sulcate, median carina faint; pronotal disk granulate, prozona more than half as long as metazona; lateral lobes with a prominent angulation on posterior ventral margins. Length of body, 21-29 mm.

This grasshopper has been reported for the area from Manitoba and Minnesota west to Alberta and Colorado and southward through Kansas to Oklahoma. It usually occurs in small bare saline or alkali areas under Great Plains conditions.

The general range indicates that this race should be looked for in at least the northwest quarter of the state.

Genus Trachyrhachis Scudder

1876 Trachyrhachys Scudder, Ann. Rept. Chief Engr. Append. JJ. p. 291.

Head comparatively large; occiput elevated, vertex with disk short and broad; frontal costa narrow, deeply sulcate throughout, slightly constricted medially, hind margin rectangular or acute; median carina notched twice in front of middle, part between sulci somewhat broadened and bilobed; lateral carinae visible only on metazona; lateral lobes with lower margin strongly oblique, lower hind angle acute, somewhat produced; tegmina and wings distinctly surpassing apex of abdomen; hind femora with apical half abruptly narrowed, its tip reaching or surpassing apex of abdomen.

Genotype: Trachyrhachys coronata Scudder.

A single species of this genus occurs in Iowa where it shows three nominal subspecies.

Trachyrhachis kiowa (Thomas)

1872 Oedipoda kiowa Thomas, Prelim. Rept. U.S. Geol. Surv. Mont. and Terr. 5th Rept. p. 461.

Color yellow to gray brown, mottled with dark brown; face and underside paler; tegmina with three fuscous crossbars, apical one usually diffused irregularly; wing varying in color as in appended key to subspecies, dark band, when present, bending toward base anteriorly; hind femora marked with fuscous as follows: trifasciate dorsally, vaguely so externally, inner face on basal area and subapical crossband; hind tibiae buffy to glaucous to dusky, usually with whitish, sub-basal ring. Length of body, males, 17-19 mm.; females, 24-26 mm.

The general range of the present species is from Manitoba to British Columbia in Canada and south and east to Colorado and Texas and east to Minnesota, Ohio, and Georgia. The species breaks into an eastern and western race with an intermediate area containing individuals of doubtful subspecific standing.

Iowa apparently lies astride this area of differentiation because typical specimens of each race appear in local collections.

Key to the Subspecies of Trachyrhachis kiowa in Iowa

1. Hind wing hyaline or slightly yellowed in basal third, without suggestion of an arcuate median fuscous crossband. T. kiowa kiowa p.241

- Hind wing yellowed in basal area and with fuscous median cross-band indicated by a central brown clouding to strongly developed complete band 2
2. Fuscous median crossband of hind wing not fully developed, indicated by faint central clouding varying to narrow broken band extending across wing T. kiowa thomasi p. 241
- Fuscous median crossband of wing dark, broad, and solid. T. kiowa fuscifrons p. 241

Trachyrhachis kiowa kiowa (Thomas)

- 1872 Oedipoda kiowa Thomas, Prelim. Rept. U.S. Geol. Surv. Mont. and Terr. 5th Rept. p. 461.
- 1900 Mestobregma kiowa Scudder, Psyche 9:92.
- 1930 Mestobregma kiowa kiowa Hendrickson, Iowa State Coll. Jour. Sci. 4:59.

The western race occurs in the northern Great Plains region from Manitoba and British Columbia south through Minnesota, Iowa, and Kansas on into Texas and west to Montana, Utah, and Arizona. It is a grassland or pasture form that usually frequents areas of sparser vegetation.

The available series of specimens, which was of considerable size, coupled with literature records indicated that the typical race of T. kiowa occurs typically and with colorless hind wings in the northwestern half of the state. However, many individuals in this same area show definite yellowing in the basal third or half of the hind wing. Several specimens from the extreme northwestern part of the state show the green pronotum and pinkish wash of the tegmina suggesting the condition described by Bruner (11) for his synonymous T. pulchella. All adult specimens had been collected between July 14 and August 27. The race was listed for the state by Knutson and Jaques (86) and Knutson (85).

Boone, Buena Vista, Clay, Dickinson, Harrison, Ida, Lyon, Monona, Osceola, Palo Alto, Plymouth, Sioux, Story, and Woodbury counties.

Trachyrhachis kiowa thomasi Caudell

- 1904 Mestobregma thomasi Caudell, Proc. Ent. Soc. Washington, 6:125.

The exact status of the forms assignable to this name is still uncertain. Hebard (59) wrote that they may constitute a race intermediate between the other two or may simply be a transitional condition between them.

Most of the several local specimens studied were from Story County where both banded-wing T. fuscifrons and clear-wing T. kiowa have been found. The others were from Adair and Black Hawk counties indicating the occurrence of a diagonal band of distribution between the other two. This ties in with the records of T. thomasi as given by Hebard (59) for Wisconsin, but is a little north of the Illinois range as indicated by the same authority.

Trachyrhachis kiowa fuscifrons (Stal)

- 1873 Psinidia fuscifrons Stal, Recensio Orthop. 1:134.
- 1892 Trachyrhachinia (!) cincta Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Trachyrhachis cincta Ball, Proc. Iowa Acad. Sci. 4:240.

The present race is a southeastern race that occurs from Pennsylvania, Ohio, Illinois, Oklahoma, and Texas south and east to Mississippi and Georgia.

This race is not uncommon in the southeastern part of the state as shown by the counties listed below. Adult records at hand during the study were for the period from July 5 to September 10. Knutson and Jaques (86) and Knutson (85) reported the present form from the state.

Cedar, Clarke, Davis, Decatur, Des Moines, Henry, Johnson, Keokuk, Lee, Louisa, Muscatine, Page, Ringgold, Story, Van Buren, and Warren counties.

Genus Metator McNeill

1901 Metator McNeill, Proc. U.S. Nat. Mus. 23:394.

Face vertical; occiput elevated, interocular width nearly or quite as great as width of an eye; fastigium with strong carinae limiting distinct impressed area; pronotum distinctly constricted medially, hind margin rectangular to acutely angled, median carina prominent; lateral lobes of pronotum with hind margin sinuate or emarginate just above acute lower angle; Tegmina and wings distinctly surpassing tips of abdomen and femora.

Genotype: Psinidia pardalina Saussure.

One species occurs in Iowa.

Metator pardalinus (Saussure)

1884 Psinidia pardalina Saussure, Mem. Soc. Phys. et Nat. de Geneve, 28:162.

Color clay-yellow to brown, pronotal disk darker; tegmina laterally with numerous prominent fuscous blotches, dorsally uniformly fuscous except for narrow lateral stripes; hind femora weakly fasciate on outer face; hind tibiae pale blue on apical half or more; pronotum sparsely granulate above; hind wings usually purplish basally, with subapical fuscous crossband. Length of body, 25-40 mm.

This insect ranges from Saskatchewan, North Dakota, Iowa and Kansas west to Alberta, Utah, and south to Arizona and Texas. In the main area of its range it occurs in limited localities within short grass prairies.

Available records of adults extend from July 15 to August 22. Iowa listings were given by Hebard (63) and Knutson (85).

Dickinson, Lyon, and Plymouth counties.

Genus Psinidia Stal

1873 Psinidia Stal, Recensio Orthop. 1:117.

Occiput strongly elevated; vertex declivent anteriorly, disk concave, lateral carinae sharp, elevated, strongly converging anteriorly; frontal costa sulcate throughout, distinctly broadened below; pronotum strongly constricted in middle, hind margin acutely angled; median carina sharp, straight; lateral carinae distinct only lateral lobes deeper than long, lower margin ascending anteriorly; tegmina surpassing apices of abdomen and femora; femora reaching or exceeding tip of abdomen.

Genotype: Oedipoda fenestralis Serville.

The single species has been collected in Iowa.

Psinidia fenestralis fenestralis (Serville)

1839 Oedipoda fenestralis Serville, Hist. Nat. des Ins. Orthop. p. 726.

1914 Psinidia fenestralis Somes, Univ. Minn. Agr. Exp. Sta. tech. Bull. No. 141, p. 60.

1915 Psinidia fenestralis Somes, 15th Rept. St. Ent. Minn. p. 60.

Color variable from clay-yellow through reddish-brown to black, face paler, cheeks gray; pronotal disk with small, oblique black dash either side near middle; tegmina with costal half bearing alternate black and white spots; hind wings yellow, orange or red on basal third, middle third with broad curved black band which reaches almost completely across wing, apical third hyaline; hind femora with three vague, oblique fuscous bars on outer upper face, inner face with basal half and crossbar at apical third black; hind tibiae greenish-yellow with base and apex blackened and a premedian brownish ring. Length of body, males, 15-18 mm.; females 19-25 mm.

The known range of this race extends from Maine south to Florida and west to Minnesota, Nebraska, and northern Texas. The preferred habitat appears to be on dry sandy ridges not too remote from lakes and larger streams.

A number of specimens were present in local collections. These had been collected between July 15 and October 20. Other local listings were given by Knutson and Jaques (86) and Knutson (85).

Dickinson, Johnson, Louisa, Lyon, Muscatine, and Plymouth counties.

Subfamily ROMALEINAE¹ Brunner

1893 RHOMALEAE Brunner, Ann. Mus. Civ. Stor. Nat. Genova, 33:134.

Vertex flat, triangular, fastigium surpassing eyes; pronotum with median carina distinct throughout, cut by three sulci, pronotum with at least prozona tectate; tegmina and wings varying from absent through partially to fully developed and surpassing apex of abdomen.

Of the thirty-six genera included in this subfamily, only one occurs in Iowa.

Genus Brachystola Scudder

1876 Brachystola Scudder, Bull. U.S. Geol. Surv. Terr. 2:267.

Vertex broad, eyes (from above) small and widely separated; frontal costa flattened, widely divergent below; pronotum convex, distinctly and equally tricarinate, lateral carinae nearly straight and widely divergent behind; disk of pronotum with numerous conspicuous rugose granules; wings and tegmina very rudimentary, the latter represented by rounded pads which do not surpass hind margin of first abdominal segment.

Genotype: Brachypeplus magnus Girard.

One of the two North American species occurs in Iowa.

¹Studies of Roberts (129) indicated that the present subfamily must be erected for the genera Romales, Brachystola, etc. Brachystola had been variously placed by earlier authors, but phallic characters studied by Roberts resulted in this placement.

Brachystola magna (Girard)

- 1854 Brachypepla magnus Girard, in Marcy, Explor. Red River of La., p. 231.
 1877 Brachypeplus magnus Bessey, 7th Bienn. Rept. Iowa State College, p. 209.
 1897 Brachistola (!) magna Ball, Proc. Iowa Acad. Sci. 4:240.

Color greenish-yellow, marked with black and yellow or brown; tegmina flesh pink with numerous black flecks between the veins; dorsum of pronotum usually with a prominent yellowed stripe just within black lateral carinae; all three pronotal carinae subequal in development, lateral ones obsoletely cut in front of middle; abdomen carinate dorsally. Length of body, 42-65 mm. (Fig. 14).

The western "lubber grasshopper" occurs east of the Rocky Mountains from North Dakota south to Texas and Mexico and eastward, with isolated colonies, as far as Minnesota, Iowa, Kansas, and Oklahoma. These isolated colonies probably represent relict colonies of a once more extensive range.

In recent years there have been no reports of economic damage by this clumsy giant grasshopper which has been collected in corn fields and on the loess bluffs in the western part of the state. However, Bessey (6) wrote that it did "a considerable amount of damage in gardens." It was also reported for the state by Osborn (98), Hebard (51, 53, 57), and Knight (84). This appears to be a late summer species because available specimens, which numbered in the dozens, had been taken between July 25 and September 16 with one second (?) instar nymph for June 10.

Crawford, Plymouth, Pottawattamie, and Woodbury counties.

Subfamily CYRTACANTHACRIDINAE Kirby

- 1910 CYRTACANTHACRIDINAE Kirby, Synon. Catal. Orthop. 3:358.

Face somewhat slanting or almost perpendicular; vertex usually convex, sides low and rounded, lateral foveolae vague or absent; pronotal disk never prominently tuberculate or wrinkled, hind margin obtusely rounded, truncated or emarginate; median carina low and nearly equal throughout; lateral carinae usually obsolete or rounded; tegmina and wings variable in length, latter not colored, always pellucid.

All types of habitats are frequented by these grasshoppers. Those found in cultivated fields and pastures frequently become of major economic importance. Among these latter are included such well-known and destructive species as the red-legged grasshopper, the lesser migratory grasshopper and the differential and two-striped grasshoppers. These four species constitute the most constant, major, crop-damaging Orthoptera within the state. Although all members of the Cyrtacanthacridinae have auditory organs present on the side at the base of the abdomen, sound production audible to the human ear is rare within this subfamily. The rigors of Iowa winters are passed in the egg stage, the warmer part of one year being sufficient to allow individuals to reach maturity.

Eight genera of the subfamily have been found in Iowa.

Key to the Genera of CYRTACANTHACRIDINAE in Iowa

1. Lateral lobes of mesosternum longer than broad (Fig. 50) *Schistocerca* p. 245
 Lateral lobes or mesosternum as broad or broader than long.
 (Fig. 49). 2
2. Pronotum with distinct, pale, calloused lateral carinae for
 almost its full length *Paratylotropidia* p. 272
 Pronotum without pale calloused lateral carinae 3
3. Lateral lobes of mesosternum subequal to space between them,
 the latter at least as wide as long (Fig. 49); pronotal sulci
 deeply impressed and blackened *Dendrotettix* p. 271
 Lateral lobes of mesosternum wider than space between them,
 the latter longer than wide; pronotal sulci not blackened 4
4. Coloration greenish, prothorax at most with a narrow black stripe
 at upper third of lateral lobes 5
 Prothorax with upper half of lateral lobe black or color not green. 7
5. Body covered with a dense coat of long silvery-white hairs,
 especially on the pronotum, pleurae and legs; pronotum
 somewhat rugose *Campylacantha* p. 249
 Body without a coat of conspicuous silvery-white hairs 6
6. Pronotum with width about two-thirds its length; subgenital plate
 of male suddenly ampliate at base of lateral margin
 *Hesperotettix* p. 250
 Pronotum with width subequal to length; subgenital plate of male with
 lateral margin straight, not ampliate near base. *Hypochlora* p. 249
7. (4). Body compressed making head look proportionally enlarged;
 postocular space at least half as long as horizontal diameter
 of eye. *Phoetaliotes* p. 271
 Body not noticeably compressed, head not appearing proportionally
 widened; postocular space usually much less than half the
 horizontal diameter of an eye. *Melanoplus* p. 251

Genus *Schistocerca* Stal

1873 *Schistocerca* Stal, *Recensio Orthop.* 1:64.

Vertex sloping anteriorly and rounding smoothly into frontal costa, disk slightly impressed, median carina absent; pronotum convex, more or less tectate on prozona, flattened on metazona, hind margin obtusely angled; median carina low, cut by three transverse sulci, principal one near middle; lateral carinae absent; tegmina and wings fully developed, at least attaining apex of abdomen.

Genotype: *Gryllus (Locusta) tartaricus* Linnaeus

This is a large American genus in which many of the nominal species treated by Scudder (141) are being reduced to subspecific standing or synonymy. In Iowa three nominal species occur.

Key to the Species of *Schistocerca* in Iowa

1. Head and lateral lobe of pronotum with a pale postocular stripe
 extending back to principal sulcus; median field of tegmina
 with large-distinct, isolated brown blotches on a subhyaline
 background. *S. americana americana* p. 246

Head and lateral lobe or pronotum without pale postocular stripe; tegmina yellowish or brownish, sometimes with a few scattered fuscous mottlings 2

2.¹ Buffy, with a pale buffy or yellowish dorsal stripe and brown markings. Dorsal bands across caudal tibiae buffy or pink. . S. lineata p. 247

Near S. lineata, both species too variable to distinguish adequately in key. Brown varying through yellowish brown to olive green, often without dorsal stripe. Dorsal bands across femora usually absent, occasionally very weakly indicated. Caudal tibiae buffy, varying through pinkish brown to dark brown . . S. alutacea p. 247

Schistocerca americana americana (Drury)

1770 Gryllus americanus Drury, Illust. Nat. Hist. 1:128.

1877 Acridium americanum Bessey, 7th Bienn. Rept. Ia. State Coll. p.210.

1892 Acridium americanum Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1893 Schistocerca americana Bruner, Bull. Div. Ent. USDA 28:10.

1897 Schistocerca americana Ball, Proc. Iowa Acad. Sci. 4:234.

1899 Schistocerca americana Scudder, Proc. Am. Acad. Arts and Sci. 34:474.

1914 Schistocerca americana Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 68.

1915 Schistocerca americana Somes, 15th Rept. St. Ent. Minn. p. 68.

Color reddish-brown with a distinct broad, yellow stripe from vertex back along midline of head and pronotum to apical third of dorsal field of tegmina; latter marked with yellow and white in addition to the prominent brown blotches; hind femora yellowish to brownish, variously streaked with black; hind tibiae reddish- to yellowish-brown. Length of body, males, 39-42 mm.; females, 48-55 mm.

If this northern form is, as Faure (27) suggested as a distinct possibility, the "solitary phase of the migratory grasshopper of Central and South America, Schistocerca paranensis (Burmeister)," then the name "American grasshopper" is well-given because the species would occur from Argentina in South America north through Central America and into North America up to latitude 40°; but because it is such a strong flier it can and does extend its range considerably northward every year with records being reported for southern Canada. It frequents numerous types of habitats and so may be met with at any collecting station. Kuitert and Connin (87) gave results of biological studies in the southeastern United States where this species has two generations per year.

Iowa data for adults showed them to be present in the state between May 15 and September 28; the great majority of them for the months of August and September which is the late summer period when this active, strong flier becomes restless and frequently makes long migrations into more northern latitudes. Additional state listings were given in literature by Hebard (55, 57), Knutson and Jaques (86), and Knutson (85).

Des Moines, Dickinson, Emmet, Henry, Johnson, Lee, Louisa, Lyon, Mahaska, Marshall, Muscatine, Page, Polk, Story, Van Buren, Washington, Wayne, and Webster counties.

¹This couplet quoted from Hebard (57), see present discussions of S. alutacea and S. lineata for further notes on separation of these two species.

Schistocerca alutacea (Harris)

- 1841 Acrydium alutaceum Harris, Rept. Ins. Mass. p. 139.
 1877 Acridium obscurum Bessey, 7th Bienn. Rept. Ia. State Coll. p. 210.
 1892 Acridium alutaceum Osborn, Proc. Iowa Acad. Sci. 1(2):117.
 1899 Schistocerca obscura Scudder, Proc. Amer. Acad. Arts and Sci. 34:445.
 1899 Schistocerca rubiginosa Scudder, Ibid. 34:462.

Color buff through yellowish-brown to olive green, with or without a prominent yellow stripe from fastigium back along midline of head and pronotum to near apex of dorsal field of tegmina; latter with or without more or less distinct fuscous mottlings in discal field; sides of abdomen usually with a submarginal row of black dots on each segment; hind tibiae yellowish through reddish to dark brown or black. Length of body, males, 23-32 mm.; females, 42-50 mm.

The general range of S. alutacea is in the eastern United States from New Hampshire and Florida west to Minnesota, Iowa, and Texas. The habitats most often frequented by this form are moist open fields and meadows.

That this species and the next are closely allied and difficult to separate is attested to by Hebard's (57) statement in his Minnesota key, "too variable to distinguish in a key." He did, however, present there the couplet copied into the present key. For further discussion on the separation of these two species please see under S. lineata, the next form.

A feeling of complete confidence in recognition of local material of these two species was never fully attained. After separating out all specimens that might reasonably be attributed to S. lineata as differentiated below, (but which admittedly may be intermediate between S. alutacea and the true, more western S. lineata) the remainder was assumed to be of this or an intermediate form. Many of the specimens so assigned agreed quite fully with the criteria set up here, but a number of them appeared to possess combinations to such an extent that one was forced to conclude their intermediacy.

Adult dates available to this study showed extremes of July 19 and October 21. Literature records were also given by Ball (2), Scudder (141, 142), Knutson and Jaques (86), and Knutson (85).

Appanoose, Calhoun, Davis, Decatur, Fremont, Henry, Iowa, Johnson, Linn, Madison, Mahaska, Muscatine, Page, Poweshiek, Story, Van Buren, Warren, and Wayne counties.

Schistocerca lineata Scudder

- 1899 Schistocerca lineata Scudder, Proc. Am. Acad. Arts and Sci. 34:465.
 1876 Acridium emarginatum Thomas, Proc. Davenport Acad. Nat. Sci. 1: 262.
 1892 Acridium emarginatum Osborn, Proc. Iowa Acad. Sci. 1(2):116.
 1897 Schistocerca emarginata Ball, Proc. Iowa Acad. Sci. 4:240.
 1899 Schistocerca albolineata Scudder, Proc. Am. Acad. Arts and Sci. 34:446.
 1908 Schistocerca albolineata Bruner, Biol. Centr. Am. Orthop. 2:297.
 1910 Schistocerca albolineata Kirby, Synop. Catal. Orthop. 3:458.

1930 ? Schistocerca alutacea Hendrickson, Ia. State Coll. Jour. Sci. 4:60.

As stated above, the separation of S. alutacea and S. lineata is difficult. In fact, even the status of these two nominal species is undecided. In literature they have been treated as distinct species, but a number of specimens in the Iowa State College collection bear labels put on them by Hebard in 1937 with the name "Schistocerca alutacea lineata Sc." and in one case a label "S.a. lineata x S.a. alutacea." This might indicate that Hebard had decided S. lineata was but a race of S. alutacea; but in the following year Hebard (63), in his Oklahoma paper, wrote of S. lineata, "very closely related to alutacea, the proper status of lineata remains undecided." After puzzling over the local series of these two species one wonders if his 1937 labelling was not correct after all. This species has been reported from Minnesota, Kansas, Oklahoma, and Texas west to Alberta, Montana, and Colorado.

Literature records thus place S. alutacea to the east of Iowa and S. lineata to the west, implying that possibly both forms may be expected in Iowa, and that if an area of intergradation occurred it should pass through Iowa. The present study confirms these assumptions. As differentiated below, the available distributional data (which lacks representation for the northeastern quarter of the state) indicates that S. lineata occurs west of a line from the north central part of the state to the southeastern corner and that S. alutacea occupies the area east of a line from the north central part of the state to the southwestern corner. This results in a large area of overlap which has its base across the southern border of the state and its apex in the north central part. Many of the specimens from this area of overlap are difficult to place in either race. There was precedence to call them intermediate individuals in the form of a specimen labelled by Hebard, "S.a. lineata x S.a. alutacea."

Recognition of this species was not possible from observation of only one or two characters but was dependent on consideration of the bulk of a series of characters. In nearly all specimens a yellowish mid-dorsal stripe was present and usually contrasted strongly with the brownish ground color. The several specimens not showing this stripe but with the same data found on more typical specimens of S.a. lineata were assumed to be from the same population and could be recognized by the presence of noticeable but diffuse crossbars on the upper surface of the hind femora. The darker part of the disk and lateral lobes of the pronotum as well as the meso- and metapleural areas usually exhibited numerous conspicuous, yellow, calloused dots. The subapical row of black dots on the abdominal segments proved to be too variable to assist in separation of local material. In addition to these color characters the individuals from the western part of the state had the prozona less tectate than the eastern specimens and also showed less development of the median carina. To summarize the characters used to separate the more western material, here considered as belonging to the species S. lineata, from the eastern specimens in Iowa the following characters were found to be useful and reliable: 1) the light brown ground color which in most cases was noticeably deepened along either side of the prominent, pale mid-dorsal stripe; 2) the banded hind femora of the specimens lacking the mid-dorsal pale line; 3) the numerous calloused yellowish spots dorsally and laterally on the thorax; and 4) the flatter prozona with lower median carina.

Occurrence of adult specimens was indicated to be from July 23 to October 2. The species was listed for the state by Knutson and Jaques (86) and Knutson (85).

Appanoose, Clarke, Davis, Decatur, Fremont, Greene, Harrison, Henry, Kossuth, Lee, Mahaska, Mills, Monona, Polk, Pottawattamie, Plymouth, Ringgold, Sac, Story, Union, Warren, Wayne, and Woodbury counties.

Genus Hypochlora Brunner

1893 Hypochlora Brunner, Ann. Mus. Civ. Stor. Nat. Genova, 33:145.

Vertex distinctly declivent anteriorly, feebly concave discally; face distinctly oblique, frontal costa slightly widened between antennal bases and feebly sulcate for most of its length; pronotum widened posteriorly, median carina low, percurrent, interrupted behind middle by principal sulcus; lateral carinae suggested by vague, calloused stripes; metazona closely punctate, hind margin broadly rounded; tegmina abbreviated, acuminate, touching or overlapping along inner margins, furcula of male straight, finger-like.

Genotype: Pezotettix alba Dodge.

The lone known species has been collected in Iowa.

Hypochlora alba (Dodge)

1876 Pezotettix alba Dodge, Canadian Ent. 8:10.

1892 Pezotettix albus Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Melanoplus albus Ball, Proc. Iowa Acad. Sci. 4:240.

Whitish to yellowish-green with darker, oblique postocular stripe crossing upper part of lateral lobes of pronotum and frequently bordered above and below by pale yellow; tegmina not surpassing third abdominal segment. Length of body, males, 17-18.5 mm.; females, 20-24 mm.

The known range of this species extends from Manitoba, Minnesota, Iowa, Kansas, and Oklahoma west to the Rocky Mountains between Montana and Texas. Both the adults and nymphs of this species are to be found on or near the hoary sage, Artemisia cana.

A number of additional state recordings were also given by Scudder (136), Somes (144, 145), Hebard (51, 53), Knutson and Jaques (86), and Knutson (85), Somes (144) wrote that for concealment on pruinose plants, "In Iowa. . . . it finds equally good concealment on Froelichia and the hoary species of Oenothera." Adult specimens have been collected between July 20 and October 18.

Cedar, Dickinson, Lyon, Muscatine, and Sioux counties.

Genus Campylacantha Scudder

1897 Campylacantha Scudder, Proc. Am. Acad. Arts Sci. 32:198.

Head prominent, occiput arched higher than pronotum, fastigium strongly declivent, vertex feebly concave; frontal costa widest above ocellus, shallowly sulcate; pronotum with median carina very low, cut behind middle by principal sulcus and sometimes also anteriorly by other sulci; lateral carinae absent; dorsum feebly tectate, feebly rugose, metazona also distinctly and closely punctured; hind margin of pronotum obtusely angled; tegmina variable, usually abbreviated.

Genotype: Pezotettix acutipennis Scudder

One species occurs in Iowa.

Campylacantha olivacea olivacea (Scudder)

1875 Pezotettix olivacea Scudder, Proc. Boston Soc. Nat. Hist. 17:472.

Color green varying to pale brown or fuscous; occiput usually with a broad, posteriorly widening median stripe; pronotum irregularly marked with calloused yellow rugulae; front and hind tibiae frequently orange; tegmina cover half to three-fourths of abdomen, overlapping along inner margins. Length of body, males, 19-23 mm.; females, 26-31 mm.

The range is stated to spread from Illinois south to Georgia and west to Nebraska and Colorado and southwest through Kansas and Oklahoma into Texas. This grasshopper frequents dry weedy fields.

One Iowa specimen of this uncommon species is an abnormally small female measuring only nineteen millimeters in length; it was collected in Clarke County on August 1 and determined by Hebard. The limited collections were made between September 4 and October 18. Hebard (51), Knutson and Jaques (86), and Knutson (85) have reported the species for the state.

Fremont, Henry, Muscatine, Pottawattamie, Taylor, and Woodbury counties.

Genus Hesperotettix Scudder

1876 Hesperotettix Scudder, Bull. U.S. Geol. Surv. Terr. 2:262.

Vertex very strongly narrowed by upper angle of eyes, declivent anteriorly; face oblique, frontal costa narrow, parallel-sided except toward upper end, sulcate throughout; pronotum elongate, median carina low, usually cut only behind middle by principal sulcus; hind margin broadly rounded or obtusely angled; tegmina and wings variable in length from shorter than abdomen to distinctly surpassing its apex; hind femora surpassing tip of abdomen.

Genotype: Caloptenus viridis Thomas.

Two of the seven United States species occur in Iowa.

Key to the Species of Hesperotettix in Iowa

1. Prozona smooth or very sparsely punctured; metazona closely punctured. H. viridis pratensis p. 250
- Prozona, metazona, and lateral lobes distinctly rugulose H. speciosus p. 251

Hesperotettix viridis pratensis Scudder

1892 Chrysochraon viridis Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Hesperotettix pratensis Scudder, Proc. U.S. Nat. Mus. 20:64.

1877 Chrysochraon viridis Bessey, 7th Bienn. Rept. Ia. State Coll. p. 207.

1897 Hesperotettix pratensis Ball, Proc. Iowa Acad. Sci. 4:240.

1914 Hesperotettix viridis Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull.

- 1915 Hesperotettix viridis Somes, 15th Rept. St. Ent. Minn. p. 70.
 1925 Hesperotettix brevipennis viridis Hebard, Proc. Acad. Nat. Sci. Phila. 77:99.
 1930 Hesperotettix pratensis Hendrickson, Ia. State Coll. Jour. Sci. 4:60.
 Color greenish with median stripe on pronotum and frequently much of dorsal field of tegmina purple; median line on dorsum of head and longitudinal bar on upper half of lateral lobes of pronotum fuscous or black; legs green, femora more or less washed with purple; vertex distinctly impressed; hind margin of pronotum broadly, obtusely angulate; tegmina reaching or surpassing apex of abdomen. Length of body, males, 17-18.5 mm.; females, 24-30 mm.

This race occurs north and west from Florida to Indiana, Minnesota, North Dakota, Colorado, Oklahoma, and Texas. It usually frequents low, marshy meadows.

Scudder (loc. cit.) described this form, with full specific standing, in part from Crawford, Dallas, and Green counties in Iowa. Specimens have been collected between July 12 and September 5. State listings were also given by Hebard (55, 68), Knutson and Jaques (86), and Knutson (85).

Buena Vista, Crawford, Dallas, Dickinson, Fremont, Greene, Harrison, Lyon, Monona, Muscatine, Osceola, Plymouth, Pottawattamie, Sioux, Story, and Woodbury counties.

Hesperotettix speciosus (Scudder)

- 1872 Pezotettix speciosa Scudder, U.S. Geol. Surv. Neb., Final Rept. p. 250.

- 1893 Acridium frontale Bruner, Bull. Div. Ent. U.S.D.A. 28:12.

Color green, sometimes fading to yellow in dried specimens, median line of pronotum and femora usually marked with purplish; dorsum of head rugulose, vertex impressed discally; pronotum broadly, obtusely angled behind; tegmina covering two-thirds to three-fourths of abdomen. Length of body, males, 19-24 mm.; females, 27-34 mm.

The range of this species is more western. It extends from Illinois to Colorado, Montana, Texas, and New Mexico, ranging as far north as Minnesota. The usual habitat is among sparse weeds on dry soils.

Late instar nymphs have been collected during June and newly emerged adults as early as July 25, with latest records of imagoes on August 26. The species has been listed for the state by Scudder (136), Somes (144, 145), Hebard (51), Hendrickson (71), and King (80). In the latter paper King corrected Somes' records as actually being based on specimens of Campylacantha olivacea olivacea.

Buena Vista, Harrison, Lyon, Mills, Monona, Muscatine, Plymouth, Pottawattamie, Sioux, and Woodbury counties.

Genus Melanoplus Stal

- 1873 Melanoplus Stal, Recensio Orthop. 1:79.

Head not more than slightly longer than pronotum; face almost vertical; vertex declivent anteriorly, rounding into frontal costa, its disk variously concave; frontal costa usually sulcate below ocellus; pronotum with low, median carina, lateral carinae usually obsolete; tegmina varying from

small oval or lanceolate pads which do not pass hind margin of first abdominal segment through all stages of brachyptery to fully developed condition and greatly exceeding apex of abdomen; wings show a parallel development; postocular stripe usually present and extending back across upper halves of lateral lobes or pronotum; male genitalia (Fig. 53) quite variable in the genus and usually furnish good specific characters.

Genotype: Acrydium femur-rubrum DeGeer.

Following Scudder's (136) "Revision" of this genus Hebard presented a series of articles on it. This series, not all parts of which are given in the "List of References" at the end of this paper, began in 1917 with Hebard (49) and appeared thereafter at irregular intervals until 1937 in the Transactions of the American Entomological Society. This genus contains more than 150 species, about 26 of which belong to Iowa's fauna.

Key to Males of the Species of Melanoplus¹ in Iowa

1. Tegmina short, not reaching apex of abdomen 2
 Tegmina fully developed, reaching or surpassing apex of abdomen 12
2. Tegmina represented by undifferentiated pads (Fig. 42). 3
 Tegmina differentiated into a lateral and a dorsal field (Fig. 41) 8
3. Hind tibiae green or bluish, never red 4
 Hind tibiae entirely or in great part red 6
4. Tegmina narrow, separated by a space greater than width of one
 of them, usually not attaining base of abdominal tergite II;
 cerci spatulate, obliquely truncated apically . . . M. gracilis p. 254
 Tegmina less than their width apart or touching or overlapping
 along inner margins 5
5. Tegmina obovate, distinctly separated; male furcula elongate,
 finger-like and divergent M. rusticus obovatipennis p. 255
 Tegmina elongate, touching or overlapping along inner margins;
 male furcula minute, triangular; cerci with upper and lower
 margins concave M. viridipes viridipes p. 254
6. Furcula nearly half as long as supra-anal plate; cerci acutely
 rounded apically, less than half as broad as basal width.
 M. dawsoni p. 255
 Furcula much less than half as long as supra-anal plate 7
7. Cerci broad at base, gradually narrowed to apex (Fig. 56).
 M. scudderi scudderi p. 256
 Cerci broad at base, abruptly narrowed in middle third, apical
 part nearly parallel-sided (Fig. 63) M. islandicus p. 258
8. Space between mesosternal lobes distinctly longer than broad 9
 Space between mesosternal lobes distinctly broader than long;
 hind femora deep red on lower face M. huroni p. 257
9. Cerci ovate or elongate, vary weakly or not spatulate apically,
 lower margin not angled (Figs. 57, 58) 10
 Cerci strongly widened apically 11
10. Furcula minute triangular processes which are well separated.
 M. fasciatus p. 257

¹As yet, no satisfactory key has been worked out for the separation of the females of this genus so they are not enumerated in the key.

- Furcula about half as long as supra-anal plate, fused along inner base M. borealis junius p. 262
11. Furcula minute, almost obsolete; cerci widely expanded apically to form transverse lobe but not incurved (Fig. 75) M. ponderosus viola p. 257
- Furcula usually about one-fourth as long as supra-anal plate; cerci moderately spatulate and incurved apically, lower margin sometimes angled near apical third (Fig. 67). M. walshii p. 256
12. Cerci not widened apically, either strongly tapering or of equal width throughout (Figs. 69, 73); furcula at least half as long as supra-anal plate 13
- Cerci with apical part distinctly wider than middle or with an angle or finger-like projection below (Figs. 68, 71, 72). . . . 16
13. Cerci with apical margin oblique, upper angle acute to slightly produced 14
- Cerci with apex evenly rounded M. flavidus flavidus p. 270
14. Mesosternum swollen to form a prominent, low, blunt tubercle anteriorly (Fig. 12); subgenital plate usually with a pair of rounded prominences or tubercles on apical margin (Fig. 53); cerci short, subquadrate (Fig. 69) 15
- Mesosternum flat, not tuberculate; subgenital plate without paired prominences at apex; cerci elongate, tapering (Fig. 73). M. femur-rubrum femur-rubrum p. 261
15. Apex of subgenital plate strongly elevated above lateral margins, with a pair of medio-apical prominences. M. bruneri p. 258
- Apex of subgenital plate at most feebly elevated above lateral margins, with a pair of medio apical prominences. M. mexicanus mexicanus p. 258
16. Cerci spatulate, expanded apical part concave on outer face. (Figs. 68, 70, 74) 17
- Cerci not spatulate, either with submedian angle or process below or with apex abruptly and angularly widened so as to be much wider than base (Figs. 65, 72, 75). 20
17. Apex of cerci symmetrical, rounder or roundly truncated (Fig. 70) 18
- Apex of cerci oblique, lower apical angle more prominent, produced (Fig. 64) M. gladstoni p. 269
18. Furcula elongate, one-third to one-half as long as supra-anal plate, slightly diverging (Figs. 54, 55); apex of subgenital plate with shallow median depression of emargination (see p. 263 for key to subspecies). M. angustipennis p. 262
- Furcula much shorter, more strongly diverging (Fig. 52); subgenital plate not notched apically 19
19. Disk of pronotum not longitudinally striped, but usually lighter than lateral lobes M. foedus fluviatilis p. 265
- Disk of pronotum longitudinally striped M. packardii p. 264
20. Cerci with prominent angle or thumb-like projection near middle of lower margin (Figs. 65, 72, 76); tegmina without rounded spots 21
- Cerci not angulate below at middle, apex expanded above and below, upper lobe broader than base of cerci (Fig. 71); tegmina with round black spots. M. punctulatus griseus p. 269
21. Furcula absent (Fig. 51). (key, p. 267). M. differentialis p. 266

- Furcula present, distinct but short 22
22. Cerci with ventral projection acute or rectangular (Fig. 74) . . . 23
 Cerci with ventral projection an elongate, finger-like process .
 (Figs. 72, 76) 24
23. Cerci bent upward to an acute apex; disk of pronotum with lateral
 longitudinal pale stripes *M. bivittatus* p. 268
 Cerci slightly curved, apex rounded with outer face bearing
 rounded concavity (Fig. 74) *M. confusus* p. 266
24. Upper arm of forked cerci much shorter and directed horizont-
 ally inwards (Fig. 76) *M. infantilis* p. 270
 Upper arm of forked cerci much the longer and directed upwards
 (Fig. 72) *M. keeleri luridus* p. 265

Melanoplus gracilis (Bruner)

1876 *Pezotettix gracilis* Bruner, Canadian Ent. 8:124.

1892 *Pezotettix gracilis* Osborn, Proc. Iowa Acad. Sci. 1(2):117.

Color above grayish-brown, underside and legs greenish; postocular stripe present, distinct; hind knees shining black; frontal costa prominent, parallel-sided, flattened, or shallowly sulcate below ocellus; pronotum convex, median carina low, distinct throughout, prozona about twice as long as metazona; latter distinctly punctate, hind margin showing a median emargination; tegmina shorter than pronotum. furcula of male variable in length from minute tabs to finger-like projections which are longer than the segment which bears them. Length of body, males, 14-16 mm.; females, 18.5-20 mm.

The range of *M. gracilis* is from Pennsylvania and Virginia west to Nebraska and Kansas. Its preference for grassy or rich weedy spots causes it to be rather local in occurrence.

Available Iowa records show adults from the last week in July to August 14. It was listed for the state by Ball (2), Scudder (136), Hebard (59), Knutson and Jaques (86), and Knutson (85). The latter wrote that he took it "among forest-floor vegetation."

Boone, Clarke, Davis, Harrison, Henry, Muscatine, Taylor, and Warren counties.

Melanoplus viridipes viridipes Scudder

1897 *Melanoplus viridipes* Scudder, Proc. U.S. Nat. Mus. 20:255.

Color brownish above, yellowish-green beneath, legs green; postocular stripe present, prominent; hind femora with two vague fuscous cross-bars above, knees black; frontal costa subparallel, feebly or not sulcate; pronotum transversely convex, median carina percurrent, slightly stronger on metazona, hind margin of latter broadly rounded or vaguely angled, without trace of median emargination; tegmina elliptical, at least as long as pronotum and reaching well onto abdominal tergite II; male cerci slender, spatulate, weakly incurved; furcula minute, triangular. Length of body, males, 16-18 mm.; females, 21-23 mm.

This species ranges from Vermont to Minnesota and south to Arkansas. It is most frequently found in low woods, especially among edgegrowth.

Specimens are not uncommon in some wooded areas of the state between June 15 and July 30. Local listings were given by Hebard (55, 60), Knutson and Jaques (86), and Knutson (85).

Benton, Boone, Cedar, Clayton, Delaware, Henry, Iowa, Jackson, Johnson, Jones, Linn, Louisa, and Madison counties.

Melanoplus rusticus obovatipennis (Blatchley)

1894 Pezotettix obovatipennis Blatchley, Canadian Ent. 26:241.

Color brownish, underside and legs paler, polished postocular stripe present and extending to base of middle coxae; hind femora with two vague crossbars above, knees black; frontal costa prominent, sides subparallel, sulcus faint or absent; pronotum with median carina percurrent; metazona densely punctate, half as long as prozona, hind margin truncate or slightly rounded; tegmina shorter than pronotum, not or barely reaching base of abdominal tergite II; male cerci slender, elongate, about one-third as long as supra-anal plate. Length of body, males, 15-16.3 mm.; females, 24-29 mm.

The range of the subspecies M.r. obovatipennis extends from Ohio west to Iowa and south and southwest to Tennessee, Arkansas, and Texas.

Adults have been collected between August 31 and November 7. Hebard (60) and Knutson (85) also reported it for the state.

Davis, Fremont, and Henry counties.

Melanoplus dawsoni (Scudder)

1875 Pezotettix dawsoni Scudder, Dawson's Rept. Geol. 49th Parallel, p. 343.

1892 Melanoplus abditum Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Melanoplus abditum Ball, Proc. Iowa Acad. Sci. 4:241.

Color gray to reddish-brown, paler beneath, postocular stripe poorly to moderately developed; abdomen appearing banded because of black fascia across basal half or less of each segment; outer face of hind femora frequently with chevron-shaped black markings; frontal costa broad, slightly convex, impressed immediately below ocellus; pronotal disk weakly convex, median carina percurrent; metazona more than half as long as prozona, hind margin obtusely and roundly angled; tegmina longer than pronotum, overlapping along inner margin, rarely fully developed; male cerci with upper margin strongly concave, apex rounded and about one-third as wide as base. Length of body, males, 15-17 mm.; females 19-22 mm.

This grasshopper is known to occur from southern Canada and northern United States southeast to Pennsylvania and west and southwest to Minnesota, Wyoming, and New Mexico. It generally seeks dry sandy soil with or without vegetative cover.

Of the 137 specimens in the collection of Iowa State College two show fully developed tegmina and wings; both of these had been collected in Lyon County on July 24. Additional state listings have been given by Ball (2), Scudder (136), Hebard (51, 53), Hendrickson (70, 71), Knutson and Jaques (86), and Knutson (85). Extremes of dates on adults available were July 2 and August 27.

Dickinson, Emmet, Fremont, Hamilton, Hancock, Humboldt, Kossuth, Lyon, Osceola, Palo Alto, Plymouth, Story, Winnebago, and Woodbury counties.

Melanoplus scudderi scudderi (Uhler)

- 1864 Pezotettix scudderi Uhler, Proc. Ent. Soc. Phila. 2:555.
 1892 Pezotettix scudderi (!) Osborn, Proc. Iowa Acad. Sci. 1(2):117.
 1897 Melanoplus scudderi Ball, Proc. Iowa Acad. Sci. 4:241.
 1897 Melanoplus scudderi Scudder, Proc. U.S. Nat. Mus. 20:214.
 1914 Melanoplus scudderi Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. no. 141, p. 77.
 1915 Melanoplus scudderi Somes, 15th Rept. St. Ent. Minn. p. 77.
 1930 Melanoplus scudderi Hendrickson, Iowa State Coll. Jour. Sci. 4:60.

Color gray to reddish-brown, postocular stripe moderately to well developed, abdomen not banded on basal halves of segments; outer face of hind femora usually unmarked; pronotal disk convex, median carina percurrent, metazona shorter than prozona, hind margin obtusely angled; tegmina elongate, overlapping along inner margins, not reaching middle of abdomen; male cercus broad, elongate, ventral margin strongly curved upwards to narrow rounded apex. Length of body, males, 16-18 mm.; females, 22.2-24.5 mm.

The range of this subspecies extends from New England to Minnesota and Nebraska south and southwest to Florida, Oklahoma, and Texas. The preferred types of habitats are woods' borders, fence rows and roadsides.

Adults of this fairly common species were collected during the period from July 18 to October 25. It has also been listed by Knutson and Jaques (86) and Knutson (85).

Boone, Cedar, Clayton, Davis, Delaware, Des Moines, Dickinson, Hancock, Henry, Jefferson, Johnson, Keokuk, Linn, Muscatine, Page, Polk, Ringgold, Story, Union, and Van Buren counties.

Melanoplus walshii Scudder

- 1897 Melanoplus walshii Scudder, Proc. Am. Philos. Soc. 36:11.
 1897 Melanoplus blatchleyi Scudder, Proc. U.S. Nat. Mus. 20:323.
 1892 Pezotettix occidentalis Osborn, Proc. Iowa Acad. Sci. 1(2):117.
 1897 Melanoplus occidentalis Ball, Proc. Iowa Acad. Sci. 4:240.
 1910 Melanoplus blatchleyi Kirby, Synon. Cat. Orthop. 3:526.

Color dark grayish-brown, dorsal area of tegmina and underside of body paler; postocular stripe variable in distinctness, often obsolete or absent, when present usually bordered medially with narrow pale stripe; hind femora yellowish-brown with two blackish crossbars on upper and outer faces, underside wholly orange or reddish, knees black; hind tibiae orange or reddish-orange with sub-basal pale ring; prozona at least one-third longer than metazona; tegmina usually one-fourth longer than pronotum, inner margins overlapping, apices subacute. Length of body, 19-29 mm.

This species is to be found from Ohio and Georgia north and west to Minnesota, Nebraska, and Kansas. It is a frequenter of upland woods and thickets.

The available adult records showed extremes of July 25 and September 10. Other Iowa reports under the present name were given by Scudder (136, 143), Knutson and Jaques (86), and Knutson (85).

Cedar, Clayton, Davis, Delaware, Des Moines, Fremont, Harrison,

Henry, Iowa, Johnson, Lee, Linn, Louisa, Marion, Mills, Muscatine, Warren, Wayne, and Webster counties.

Melanoplus ponderosus viola (Thomas)

1876 Pezotettix viola Thomas, Bull. Ill. Mus. Nat. Hist. 1:68.

Color olive to grayish-brown, face and underside grayish; postocular stripe broken to distinct; tegmina usually with small square fuscous spots discally; hind femora with two moderate to strong crossbands on outer, upper, and usually inner faces, under surface yellowed or pinkish-red; hind tibiae red or orange-yellow beyond basal pale ring and premedial fuscous annulus; pronotum with median carina much weaker on prozona. Length of body, 25-34 mm.

The present race is known to occur up the Mississippi Valley from Louisiana and Mississippi north to Illinois and Iowa and west into Oklahoma. It frequents undergrowth in woods.

The large series collected by King, and reported on in part by him in 1940, marks an appreciable extension of range northward for this race. Those specimens had been taken on August 7 and September 12 and 14 in Clayton County.

Melanoplus fasciatus (Walker)

1870 Caloptenus fasciatus Walker, Cat. Dermap. Saltat. British Mus. 4:680.

1896 Melanoplus alleni Scudder, Rept. Ent. Soc. Ontario. 26:66.

1897 Melanoplus alleni Scudder, Proc. U.S. Nat. Mus. 20:274.

1901 Melanoplus alleni Scudder, Proc. Davenport Acad. Sci. 8:53.

1910 Melanoplus alleni Kirby, Synon. Cat. Orthop. 3:521.

Color dull grayish-brown, clay-yellow below; postocular stripe and sides of abdomen at base black; hind femora yellowish-brown with two fuscous crossbars on outer and upper faces, usually reddish on underside; knees black; hind tibiae reddish with sub-basal pale ring; prozona slightly longer than metazona; tegmina covering two-thirds to three-fourths of abdomen. Length of body, 17-23 mm.

M. fasciatus is in main a boreal species which ranges across the continent in southern Canada and south into the United States to New Jersey, Indiana, Missouri, and Colorado. It usually frequents dry, open woods.

The species M. alleni of Scudder, now considered a straight synonym of M. fasciatus, was described from "Two males. Crawford County, Iowa, July 13-24, J.A. Allen." Available records of local material indicated the adult season to extend from July 13 to September 10. Other previous listings for the state were given by Hebard (53, 57) and King (61).

Crawford, Emmet, Fremont, Guthrie, Monona, Story, and Webster counties.

Melanoplus huroni Blatchley

1898 Melanoplus huroni Blatchley, Psyche 8:195.

Color dark brown marked with black above, postocular stripe present, bordered below by yellow; tegmina with row of quadrate fuscous spots on discal area; hind femora yellow with two oblique black bars on outer, upper and inner faces; knees fuscous; tibiae deep pinkish-red; frontal costa

prominent, narrow, feebly sulcate below ocellus; pronotum with median carina more distinct on metazona, latter slightly shorter than prozona, coarsely and closely punctate, hind margin broadly and obtusely angled; tegmina covering nearly half of abdomen; male cerci with basal third swollen, apical two-thirds slender, feebly curved, apex blunt; furcula short, widely separated finger-like projections. Length of body, males, 19-21 mm.; females, 28-23 mm.

This is definitely a northern form. It ranges from Ontario to British Columbia in southern Canada and south into the United States to Michigan, Iowa, South Dakota, and Wyoming. The usual habitat is in forest conditions.

Knutson (85) listed material collected in Cedar County between July 2 and August 1.

Melanoplus islandicus Blatchley

1898 Melanoplus islandicus Blatchley, Psyche 8:196.

Color dark brown above, yellowish-green beneath, postocular stripe distinct to obsolete; hind femora faintly banded on upper and inner faces; hind tibiae deep red with faint black ring at base; pronotum with median carina distinct only on metazona; tegmina oval, about three-fourths as long as pronotum, inner margins usually well separated. Length of body, males, 14.5-17 mm.; females, 19-24 mm.

The northern range occupied by this species extends east from Manitoba, Minnesota, and Iowa to Ontario, Pennsylvania, Maryland, and Virginia. Specimens have been taken frequently from the edges of clearings in forests.

No specimens were available for study, but Hebard (57) did report it from Allamakee, Fremont, and Taylor counties.

Melanoplus bruneri Scudder

1897 Melanoplus bruneri Scudder, Proc. Am. Philos. Soc. 36:18.

Color reddish-brown above, greenish-yellow below; postocular stripe of prozona appearing as a blotch; tegmina vaguely spotted in median area; hind femora dull yellow, faintly barred on upper and inner faces; hind tibiae pale red to yellow; pronotum nearly flat above, metazona slightly shorter than prozona and finely, densely punctate; furcula touching at base, elongate, reaching beyond middle of supra-anal plate. Length of body, 20-25 mm.

M. bruneri has been reported as ranging from Ontario west and north to British Columbia and Alaska and south into the northern United States to Wisconsin, Nebraska, and Oregon. It is said to prefer bushy undergrowth as a habitat.

The only record available for local occurrence of this species was given in literature by Hebard (57) for "Onawa in southwestern Iowa." Onawa is in Monona County. The inclusion of M. bruneri in the "Revised List" of Knutson and Jaques (86) was admittedly based on Hebard's listing.

Melanoplus mexicanus mexicanus (Saussure)

1861 Pezotettix mexicana Saussure, Rev. et Mag. Zool. ser. 2, 13:160.

1868 Caloptenus spretus Glover, Rept. U.S.D.A. 1867, p. 65.

- 1868 Caloptenus spretus Walsh and Riley, Am. Ent. 1:73.
 1873 Caloptenus spretus Glover, Rept. U.S.D.A. 1873, p. 136.
 1876 Caloptenus spretus Putnam, Proc. Davenport Acad. Nat. Sci. 1:187.
 1876 Caloptenus spretus Merrisk, Field and Forest, 2:65.
 1877 Caloptenus spretus Bessey, 7th Bienn. Rept. Ia. State Coll. p. 209.
 1891 Caloptenus spretus Osborn and Gossard, Iowa Exp. Sta. Bull. No. 14, p. 174.
 1892 Melanoplus spretus Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1897 Melanoplus atlanis Scudder, Proc. U.S. Nat. Mus. 20:181.
 1897 Melanoplus spretus Ball, Proc. Iowa Acad. Sci. 4:241.
 1897 Melanoplus atlanis Ball, Ibid. 4:241.
 1914 Melanoplus atlanis Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 80.
 1914 Melanoplus spretus Somes, Ibid. 141:80.
 1925 Melanoplus spretus Hebard, Proc. Acad. Nat. Sci. Phila. 77:113.
 1930 Melanoplus mexicanus atlanis Hendrickson, Iowa State Coll. Jour. Sci. 4:60.
 1936 Melanoplus spretus Knight, Ann. Am. Ent. Soc. 29:580.

Color reddish- or grayish-brown, paler beneath; postocular stripe entire or broken into blotches, not extending onto lateral lobes of metazona; tegmina distinctly flecked with fuscous on median area; hind femora with two dark bars across upper face, sometimes continued as faint oblique ones on outer face, underside usually pinkish or pale orange red; knees black; hind tibiae usually red, sometimes yellow or bluish; pronotum expanding on metazona, disk flat, hind margin obtusely angled; male supra-anal plate broadly triangular; furcula diverging, about one-third as long as supra-anal plate; subgenital plate narrowing apically, apex somewhat thickened, elevated, with distinct median apical notch. Length of body, 17-27 mm. (Fig. 12).

The range of this serious pest, the "lesser migratory grasshopper," is from Nova Scotia south to Florida and west to the Pacific coast and Texas and thence on into Mexico. It appears equally at home in woods, cultivated and uncultivated fields and on lawns.

Besides breaking into subspecies, this species is known to have produced a long-winged migratory phase which was responsible for the destructive "locust plagues" of the 1800's. These insects moved in dense clouds of countless numbers and did untold damage to native and cultivated plants. The devastated areas left behind by these hungry hordes were often without food for man or animal. The insects were so numerous that they actually prevented the progress of railroad trains when the rails were greased with their smashed bodies.

This exceptionally destructive migratory phase had been treated in literature under the specific, subspecific or phase name spretus.

A very full discussion of the migratory phase in grasshoppers was given by Key (79). Although none of the species discussed occur in North America the conclusions undoubtedly apply equally well to all species demonstrating this phenomenon. He concluded that environmental as well as physiological factors are responsible for the development of a swarming phase in these grasshoppers and that the transition from one phase to another may proceed in either direction depending on changes in the critical factors. In general the theory considers that first a great increase

in the number of scattered solitary individuals results from favorable environmental conditions. Then adverse conditions restrict the favorable habitats available and the grasshoppers are concentrated in limited areas. This crowding causes greater activity in the individual through visual and tactile stimuli from other individuals. The greater activity leads to increased fecundity and induces morphological and color changes which in turn cause increased activity resulting in even greater fecundity and morphological changes and gives rise to the "vicious cycle" of accumulating effects. After reaching a certain tempo of activity, which can be detected or predicted from morphological criteria, the individuals of the populations emigrate and give rise to the migrating throngs of "locust plagues." The complexity of this phenomenon was well indicated in Key's review of the efforts of many workers to explain it.

For a discussion of migratory forms in M. mexicanus the work of Faure (27) may be consulted. With the same experimental technique that he had used to demonstrate the solitary and gregarious phases in the South African grasshopper, Locustana pardalina, Faure found that with crowding of nymphs during rearing the type of coloration described for nymphs of the gregarious phase (spretus) was produced, and that if nymphs were reared individually the coloration of the solitary phase resulted. Faure then called upon J.A.G. Rehn for a summary of morphological characters separating the two phases; Rehn's reply indicated only a few slight differences.

Brett (9) also studied the possible effects of the environment on the development of individuals of this species. His work agreed with others that nymphs growing under crowded conditions developed the coloration of the gregarious phase while those developing solitarily had the coloration of the solitary phase. But in commenting on the effects of crowding on the resulting adults, he wrote, "Adult grasshoppers which had developed under crowded conditions showed no colors or patterns which would distinguish them from those reared under solitary conditions. Individuals produced under crowded conditions were slightly smaller and shorter winged than the solitary ones. Factors responsible for the development of large, long-winged adults of M. mexicanus are not the same as those which produce the color pattern of gregaria; However, the circumstances in nature which will produce one will probably result in the other." He further found that naturally and experimentally larger body size and considerable lengthening of the wings in adults result from conditions "more favorable to the development of the migratory grasshopper."

Another very interesting result of Brett's work was the discovery that "Specimens collected from alfalfa are often unusually small. It is not a rare thing during late September and October to find second generation adults which are diminutive and have the organs of flight greatly reduced." He further wrote that, "Grasshoppers reared on alfalfa in the laboratory were not only reduced in body size but also had less fecundity. Paired individuals seldom copulated. The few pods which were deposited contained but five or six eggs each and were mostly composed of froth." He then suggested as a possible explanation for the absence of the migratory phase in its old breeding ground, "Historically, the disappearance of the Rocky Mountain locust appears to have coincided with the spread of alfalfa throughout the breeding grounds."

In answer to a question on the matter, Gurney (MS.) wrote, "There is no clearly defined character separating the optimum of M. mexicanus mexicanus from spretus. The migratory phases of grasshoppers which occasionally have a decided response to environmental conditions producing an extreme long-winged and actively migrating type of population hardly deserve separate names in a strict nomenclatorial sense. Thus, spretus falls as a synonym of mexicanus mexicanus." The migratory individuals usually show markedly elongated tegmina and wings and a much heavier pronotal development which is apparently an accommodation for the more powerful musculature necessitated for operating the larger flight organs over longer periods of time.

In Iowa this species passes the winter as eggs buried in the ground. The young emerge from the egg and the ground in spring and usually attain adulthood by early June. Adults may be found from that time until the last survivors are killed by the frosts of autumn. Drake and Tauber (21) listed this as the most serious economic species of grasshopper in Iowa and gave a discussion of its importance to Iowa agriculture.

Adair, Adams, Appanoose, Audubon, Benton, Boone, Buena Vista, Carrol, Cass, Cedar, Cherokee, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Dickinson, Emmet, Fremont, Greene, Guthrie, Hamilton, Hancock, Hardin, Harrison, Henry, Humboldt, Ida, Iowa, Jackson, Jefferson, Johnson, Keokuk, Lee, Linn, Louisa, Lucas, Lyon, Madison, Marshall, Mills, Monona, Monroe, Muscatine, O'Brien, Osceola, Page, Plymouth, Pocahontas, Polk, Pottawattamie, Ringgold, Sac, Shelby, Sioux, Story, Tama, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, and Woodbury counties.

Melanoplus femur-rubrum femur-rubrum (DeGeer)

- 1773 Acrydium femur-rubrum DeGeer, Mem. L'Hist. Nat. Ins. 3:498.
 1868 Caloptenus femur-rubrum Walsh and Riley, Am. Ent. 1:73.
 1876 Caloptenus femur-rubrum Thomas, Proc. Davenport Acad. Nat. Sci. 1:260.
 1877 Caloptenus femur-rubrum Bessey, 7th Bienn. Rept. Ia. State Coll. p. 209.
 1878 Caloptenus femur-rubrum Packard, Rept. U.S. Ent. Comm. 1:77, 135.
 1892 Melanoplus femur-rubrum Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1893 Melanoplus femur-rubrum Osborn, Papers on Iowa Insects, p. 57.
 1897 Melanoplus femur-rubrum Ball, Proc. Iowa Acad. Sci. 4:241.
 1928 Melanoplus femur-rubrum Hendrickson, Ann. Ent. Soc. Am. 31:133.
 1930 Melanoplus femur-rubrum Hendrickson, Iowa State Coll. Jour. Sci. 4:60.
 1934 Melanoplus femur-rubrum Hendrickson, Proc. Iowa Acad. Sci. 40:238.

Color reddish-, yellowish- or grayish-brown, postocular stripe prominent to obsolete; tegmina with or without a sprinkling of fuscous spots; hind femora with two or three distinct dark crossbars on inner upper face; knees black; hind tibiae usually red, rarely yellowish; pronotum with disk flat and distinctly widened posteriorly. Length of body 17-27 mm.

Hebard (51) gave the range of the "red-legged grasshopper" as "over

the entire United States, in the arid sections confined to the watered areas." It occurs along roadsides, in fields, pastures, meadows, lawns, and open woods.

M. femur-rubrum, like M. mexicanus, is, as Ball (loc. cit.) put it, "too common." However, it is rated fourth in economic importance among the local grasshoppers by Drake and Tauber (24). Adults are abundant by mid-July and are to be found from that time until frost. Knutson and Jaques (86) and Knutson (85) also reported it for the state.

Adair, Appanoose, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Buena Vista, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clarke, Clay, Clayton, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson, Emmet, Floyd, Franklin, Fremont, Greene, Grundy, Hancock, Harrison, Henry, Howard, Ida, Iowa, Jackson, Jasper, Jefferson, Johnson, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Mahaska, Marion, Marshall, Mills, Mitchell, Monona, Monroe, Montgomery, Muscatine, Osceola, Page, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winnebago, Winneshiek, Woodbury, Worth, and Wright counties.

Melanoplus borealis junius (Dodge)

1876 Pezotettix junius Dodge, Canadian Ent. 8:9.

1892 Melanoplus junius Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Melanoplus junius Ball, Proc. Iowa Acad. Sci. 4:241.

1897 Melanoplus extremus Scudder, Proc. U.S. Nat. Mus. 20:289.

1914 Melanoplus extremus Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 85.

1915 Melanoplus extremus Somes, 15th Rept. St. Ent. Minn. p. 86.

Color yellowish- or grayish-brown, underside and legs yellowish; hind femora with vague fuscous mottlings dorsally and yellow or pale orange ventrally; hind tibiae yellow to pale red; prozona quadrate, slightly longer than metazona, latter with hind margin obtusely angled; females usually nearly or quite fully developed tegmina and wings; males with tegmina occasionally reaching as far as base of genital segment. Length of body, 15-24 mm.

This southern race of a northern species ranges from New England west and northwest to North Dakota and British Columbia and south to Pennsylvania, Indiana, Illinois, Missouri, and Nebraska. It is said to frequent moist situations such as damp meadows, bogs, and sedgy swamps.

The several local specimens available for study were taken between June 19 and August 29. This subspecies was also reported for the state by Hebard (51), Knutson and Jaques (86), and Knutson (85). The latter noted finding a series of specimens in an open grassy patch in a woods.

Boone, Clay, Dickinson, Emmet, and Johnson counties.

Melanoplus angustipennis (Dodge)

1877 Caloptenus angustipennis Dodge, Canadian Ent. 9:111.

Color grayish- through reddish-brown, postocular stripe distinct to vague; tegmina with or without black spots along median area; hind femur

vaguely banded or suffused with fuscous, under surface sometimes red-ened; hind tibiae red or bluish, usually paler toward base. Length of body, 19-30 mm.

The general range of this species extends from Ontario and Manitoba in southern Canada south and east of the foothills of the Rocky Mountains to Montana, Colorado, and Texas and east and southeast to Indiana and Georgia. It usually inhabits sandy soil. Both subspecies, (so designated by Hebard (65)) which are weakly separated by the key given below, have been found in Iowa.

Key to the Subspecies of Melanoplus angustipennis in Iowa

1. Male furcula shorter, about one-third as long as supra-anal plate; body usually shorter, length 19-23 mm. M. angustipennis angustipennis
- Male furcula longer, about half as long as supra-anal plate; body usually longer, length about 23-30 mm. M. angustipennis impiger

Melanoplus angustipennis angustipennis (Dodge)

- 1877 Caloptenus angustipennis Dodge, Canadian Ent. 9:111.
 1892 Melanoplus angustipennis Osborn, Proc. Iowa Acad. Sci. 1(2):118.
 1893 Melanoplus angustipennis Bruner, U.S. Div. Ent. Bull. (o.s.) 28:25.
 1897 Melanoplus angustipennis Ball, Proc. Iowa Acad. Sci. 4:240.
 1914 Melanoplus angustipennis Simes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 87.
 1915 Melanoplus angustipennis Simes, 15th Rept. St. Ent. Minn. p. 87.
 1925 Melanoplus angustipennis Hebard, Proc. Acad. Nat. Sci. Phila. 77: 117.
 1928 Melanoplus angustipennis Hebard, Ibid. 80:288.
 1935 Melanoplus angustipennis Knutson and Jaques, Proc. Ia. Acad. Sci. 42:182.
 1937 Melanoplus angustipennis Knutson, Field and Lab. 5:46.

The known range of this subspecies extends east from the foothills of the Rocky Mountains to Ontario, Michigan, and Indiana, as far north as Manitoba and Montana and south to Indiana, Illinois, Iowa, Kansas, and Colorado. This insect is usually to be found in grasslands on poor sandy soils.

Adult season for this subspecies judging from available dates, extends from June 24 to October 20. Relatively few specimens from the state were at hand.

Boone, Cedar, Fremont, Harrison, Johnson, Lee, Monona, Muscatine, Pottawattamie, and Story counties.

Melanoplus angustipennis impiger Scudder

- 1897 Melanoplus impiger Scudder, Proc. Am. Philos. Soc. 36:26.
 1914 Melanoplus impiger Simes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 88.
 1915 Melanoplus impiger Simes, 15th Rept. St. Ent. Minn. p. 88.

- 1931 Melanoplus impiger Hebard, Proc. Acad. Nat. Sci. Phila. 83:188.
 1932 Melanoplus impiger Hebard, Univ. Minn. Agr. Exp. Sta. Tech.
 Bull. No. 85, p. 39.
 1935 Melanoplus impiger Knutson and Jaques, Proc. Iowa Acad. Sci. 42:
 183.
 1937 Melanoplus impiger Knutson, Field and Lab. 5:46.

The range of this subspecies occupies the area from Kansas and Iowa south to Texas, Oklahoma, Arkansas, South Carolina, and Georgia. It is said to occur in open forests on sandy soil.

In reducing M. impiger to subspecific standing Hebard (63) wrote, "The insect described as impiger represents nothing but the southeastern optimum of angustipennis, very different in general appearance but differing only sufficiently to warrant recognition of a weakly defined race."

This is an uncommon form in Iowa where it is known only from a few western counties. There they had been caught in August.

Fremont, Monona, and Taylor counties.

Melanoplus packardii Scudder

- 1878 Melanoplus packardii Scudder, Proc. Boston Soc. Nat. Hist. 19:288.

Color pale brown to yellowish-brown, usually with a broad, dark brown median stripe extending from apex of vertex backward for full length of pronotum, often absent from the latter; postocular stripe occupying only upper fourth of lateral lobe of pronotum; tegmina with or without fuscous spots along median area; hind femora yellowish, upper surface with two dark crossbars, upper edge of outer face usually with a narrow, poorly defined, longitudinal, fuscous stripe; hind tibiae glaucous to bright red; pronotum with median carina present only on metazona; latter about four-fifths as long as prozona, hind margin broadly obtusely angled or sub-rounded. Length of body, 22-33 mm.

"Packard grasshopper" is known to occur in southern Canada in Saskatchewan, Alberta, and British Columbia and then south into the United States to California, New Mexico, and Texas and east to Minnesota, Iowa, Kansas, and Oklahoma. This species is a native of the prairies and plains but does not avoid cultivated fields in that same region.

This species is very close to M. foedus fluviatilis Bruner and in some parts of their ranges cannot be safely separated without recourse to the valves of the aedeagus. Since this is an internal structure it does not offer such a convenient character as does the color pattern mentioned in the key. The great majority of specimens studied (including all Iowa material) were all easily identified by color. If, however, uncertainty exists the characters of the aedeagus given in the accompanying couplet may be used:

Both pairs of valves of aedeagus of equal length. . . . M. packardii

One pair of the valves decidedly longer than the other . . .

. M. foedus fluviatilis

The hind tibiae of all adults, which were collected between July 21 and August 26, were glaucous in color. Although this species is known to be an abundant range pest farther west, in Iowa it is not found in any threatening numbers. Numerous references to the local occurrence of this species are to be found in literature. These have been given by Ball (2),

Scudder (136), Hebard (51, 53, 55, 57, 63), Hendrickson (71), Knutson and Jaques (86), Knutson (85), and King (80).

Appanoose, Clarke, Clay, Dallas, Dickinson, Emmet, Fremont, Harrison, Humboldt, Jefferson, Lyon, Marshall, Mills, Monona, Plymouth, Pottawattamie, Ringgold, Sioux, Taylor, Van Buren, Warren, and Woodbury counties.

Melanoplus foedus fluviatilis Bruner

1897 Melanoplus fluviatilis Bruner, Ann. Rept. Neb. Bd. Agr. for 1896, p. 136.

1925 Melanoplus fluviatilis Hebard, Proc. Acad. Nat. Sci. Phila. 77:117.

1928 Melanoplus fluviatilis Hebard, Proc. Acad. Nat. Sci. Phila. 80:287.

Color grayish- or yellowish-brown, paler underneath; occiput and pronotal disk greenish- or brownish-gray, strongly contrasting with broad, sharply outlined, postocular stripe; tegmina with or without faint fuscous spots along median area; hind femora yellowish-brown, usually with two fuscous crossbars on upper face, lower surface usually bright red; hind tibiae glaucous; metazona slightly shorter than prozona, hind margin broadly, obtusely angled. Length of body, 22-26 mm.

The range of this species is confined to the north central part of the United States from Wisconsin and Illinois west to Montana and Colorado, north to Minnesota and North Dakota and south to Missouri (Specimens in author's collection) and Kansas. Open or sparsely weeded sandy soil is the type of habitat in which this grasshopper is most often found.

Extremes of adult dates on local specimens were July 7 and October 20. State listings were also given by Knutson and Jaques (86) and Knutson (85).

Cedar, Clay, Delaware, Dickinson, Emmet, Fremont, Harrison, Henry, Johnson, Lyon, Monona, Muscatine, Pottawattamie, Sioux, Story, and Woodbury counties.

Melanoplus keeleri luridus (Dodge)

1876 Caloptenus luridus Dodge, Canadian Ent. 8:11.

1885 Melanoplus luridus Bruner, Bull. Washburn Coll. 1:138.

1892 Melanoplus luridus Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Melanoplus luridus (!) Ball, Proc. Iowa Acad. Sci. 4:240.

1897 Melanoplus luridus Scudder, Proc. U.S. Nat. Mus. 20:346.

Color dark grayish-brown, paler below, upper surface varied with fuscous; postocular stripe distinct or obsolete; tegmina mottled with fuscous along median area; hind femora above and frequently on outer face with two dark crossbars; hind tibiae bright coral red; pronotum widening posteriorly, median carina more distinct on metazona which is punctate. Length of body, 17-25 mm.

The range of M. keeleri luridus ranges across southern Canada and northern United States west to Manitoba and Montana and south to Idaho, Colorado, Kansas, and into Arkansas where it merges with the southeastern nominal race. Specimens may be found in pastures, on sandy prairie stretches or on sparsely wooded hillsides.

Extremes of adult dates available during this study were June 23 and October 30. During late August it was found abundantly on the loess river bluffs in the western part of the state. Hendrickson (70, 71), Knutson and

Jaques (86), and Knutson (85) also reported it for Iowa.

Boone, Cedar, Dallas, Davis, Dickinson, Fremont, Hancock, Harrison, Iowa, Johnson, Linn, and Lyon counties.

Melanoplus confusus Scudder

1897 Melanoplus confusus Scudder, Proc. Am. Philos. Soc. 36:29.

1897 Melanoplus minor Scudder, Proc. U.S. Nat. Mus. 20:338.

1897 Melanoplus minor Ball, Proc. Iowa Acad. Sci. 4:240.

1914 Melanoplus minor Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 90.

1915 Melanoplus minor Somes, 15th Rept. St. Ent. Minn. p. 91.

Color above yellowish- to reddish-brown, postocular stripe present, frequently broken or obsolete; tegmina maculate with fuscous along median area; hind femora brownish-yellow, two fuscous bands of upper face becoming oblique on outer face, underside orange-red; hind tibiae usually pale glaucous, rarely yellow or reddish; pronotum with median carina present throughout, prozona broadly convex, metazona flattened. Length of body, 16-29 mm.

This species ranges from coast to coast across southern Canada and the northern United States as far south as North Carolina, Indiana, Missouri, Kansas, Colorado, Arizona, and New Mexico. It can be found on grasses and low herbs in fields and open woods.

All Iowa specimens studied had the hind tibiae pale glaucous. They had been collected between May 23 and August 24. Hendrickson (70, 71), Knutson and Jaques (86), and Knutson (85) reported the species for the state.

Buena Vista, Cedar, Clinton, Davis, Dickinson, Hancock, Kossuth, Lyon, Mills, Muscatine, Plymouth, Pottawattamie, Sioux, Story, Van Buren, and Woodbury counties.

Melanoplus differentialis (Thomas)

1865 Acridium differentiale Thomas, Trans. Ill. St. Agr. Soc. 5:450.

1873 Caloptenus differentialis Thomas, Rept. U.S. Geol. Surv. Terr., 5:166.

1868 Caloptenus differentialis Walsh and Riley, Am. Ent. 1:16.

1876 Caloptenus differentialis Putnam, Proc. Davenport Acad. Nat. Sci. 1:266.

1877 Caloptenus differentialis Bessey, 7th Bienn. Rept. Iowa State Coll. p. 209.

1883 Caloptenus differentialis Bruner, Rept. U.S. Ent. Comm. 3:54.

1893 Caloptenus differentialis Gossard, Proc. Iowa Acad. Sci. 1(3):96.

Generally color yellowish-brown through brown to greenish-brown. paler beneath; postocular stripe reduced to separate black marks which are confined chiefly to sulci on sides of thorax; hind femora yellow with conspicuous chevron-shaped black marks on outer face; hind tibiae yellow with a sharp, narrow black ring near base, upper inner row of spines entirely black; median carina of pronotum more distinct on metazona; male cercus with lower length from base to apex of ventral process less than posterior length from tip of ventral process to tip of cercus. Melanistic form: color dark brown to black, anterior two pairs of legs lighter

but variously suffused with darker color; hind femora yellow with basal, premedian and apical area shining black, underside usually wholly yellow; hind tibiae with a distinct yellow ring beyond black base and with a broad, premedian fuscous suffusion which sometimes extends almost to apex. Length of body, 28-44 mm.

The range of the "differential grasshopper" as occupied by its two races (for discussion of which see paragraph below) is countrywide but highly discontinuous in the far east and west. It is known from Pennsylvania and New Jersey west to California, north to Montana and North Dakota and south to Louisiana, Texas, and Arizona and on into Mexico. In addition to its preferred habitat in low damp meadows and fields, this pestiferous grasshopper abounds along roadsides and in drier fields and stands of cultivated plants. Under Great Plains conditions in the central United States there appears, as a small percentage of the population, a melanistic phase which shows in the nymphs as well as the adults. R.L. King (81) performed a series of breeding experiments in which he crossed melanistic individuals with normally colored individuals and with other blackened individuals. From the results he concluded; 1) that the melanism is recessive because in a cross it did not appear in the F_1 generation but did reappear in the F_2 generation in approximately 1:3 ratio with light colored individuals, and 2) the character is not sex-linked because the sexes appear in equal numbers in both color phases.

Because of its great abundance and habit of frequenting cultivated fields this insect has become a major crop pest in Iowa; it vies with M. bivittatus in ranking second only to M. mexicanus for the dubious honor of being the most destructive orthopteron in the state. Nymphs of both color forms have been found from early June until middle August; adults of both forms bore earliest records for mid-July and occurred until late October.

In addition to the half dozen Iowa records cited above a number of state listings were given without indication of subspecific separation. These were by Osborn (98, 99), Redtenbacher (108), Scudder (136), Ball (2), Hendrickson (71), Knutson and Jaques (86), and Knutson (85).

At a more technical stage of study this species was shown by Roberts (130) to break into a western and an eastern subspecies. These two races are at present separable only on the basis of characters furnished by the internal male genitalia as indicated in the following couplet:

Key to Iowa Subspecies of Melanoplus differentialis

1. Apical part of aedeagal valve strongly produced, slender; cavity obsolete, channel more shallow (Fig. 59) M. differentialis differentialis p. 267
- Apical part of aedeagal valve weakly produced, incurved; cavity and channel deep, sharply delimited (Fig. 60). M. differentialis nigricans p. 268

Melanoplus differentialis differentialis (Thomas)

1865 Acridium differentiale Thomas, Trans. Ill. St. Agr. Soc. 5:450.

Based on male specimens only, the range of this eastern race in Iowa was determined to occupy the eastern half of the state as far west as

Cerro Gordo, Boone, and Marion counties. The season and habits of this race differed in no noticeable respect from the discussion given above, except that it does not appear to show the melanistic phase. Roberts (130) gave a map record for the eastern part of the state.

Melanoplus differentialis nigricans Cockerell

1917 Melanoplus differentialis variety nigricans Cockerell, Ent. Record 29:247.

Again based exclusively on males, the range of this western race in Iowa was found to occur west of a diagonal line from Allamakee County in the northeastern corner of the state, southwest through Story County into Taylor County which is the third county from the southwestern-most corner of the state. This race contained all melanistic specimens studied from the state, one of which had been collected in the extreme northeastern county. Except for the color phase, field observations detected no difference in habits or habitats between this and the eastern race. The three map records given by Roberts (130) were all for the extreme northwestern corner of the state.

M. differentialis (including both races) has been taken in 92 of the 99 counties of the state. The 7 counties from which no specimens were seen all occur in the northeastern quarter of the state and are herewith listed: Butler, Chickasaw, Fayette, Franklin, Grundy, Worth, and Wright. This localization of unrepresented areas indicates no peculiarities in the distribution of the species, but simply reflects the fact that the northeastern quarter of the state is the most poorly collected orthopterologically.

The nearly eighty male specimens whose internal genitalia were examined for subspecific assignment were found to be distributed in the following counties:

M. differentialis differentialis - Benton, Boone, Cerro Gordo, Davis, Des Moines, Dubuque, Henry, Iowa, Johnson, Lee, Marion, Marshall, Scott, Story, Tama, and Washington.

M. differentialis nigricans - Allamakee, Audubon, Boone, Buena Vista, Carroll, Cherokee, Crawford, Dickinson, Fremont, Harrison, Ida, Lyon, Madison, Monona, O'Brien, Plymouth, Pocahontas, Pottawattamie, Sac, Shelby, Story, Taylor, Union, and Webster.

Melanoplus bivittatus (Say)

1825 Gryllus bivittatus Say, Jour. Acad. Nat. Sci. Phila. 4:308.

1876 Caloptenus bivittatus Putnam, Proc. Dav. Acad. Nat. Sci. 1:266.

1877 Caloptenus bivittatus Bessey, 7th Bienn. Rept. Ia. State Coll. p. 209.

1893 Caloptenus bivittatus Gossard, Proc. Iowa Acad. Sci. 1(3):96.

1897 Melanoplus femoratus Scudder, Proc. U.S. Nat. Mus. 20:363.

Color olive-brown to reddish- or yellowish-brown above, much paler beneath, a narrow pale line extending from the upper inner angle of the eyeback along sides of pronotal disk nearly to tip of tegmina; latter without fuscous spots on discal area; legs yellow, hind femora with two or three blackish crossbars on inner upper face and usually with a fuscous stripe along upper outer face; hind tibiae red, purplish-brown, blue or yellow. Length of body, 23-40 mm.

The "two-striped grasshopper" occurs generally throughout the United States, being absent only in the southeastern part and in some of the more arid regions of the west. It prefers rank vegetable growth such as is common in marshes, along the edges of cultivated fields and in woods' borders. However, it will move freely into cultivated crops where it actually does sufficient damage to cause it to be ranked with other species of Melanoplus as a major crop pest.

It was listed for the state under the present name by Osborn (98), Ball (2), Scudder (136), Somes (144, 145), Hendrickson (71), Hebard (55), Knutson and Jaques (86), and Knutson (85). Available adult records extend from August 18 until the frosts of fall.

Adair, Audubon, Bremer, Buena Vista, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Clay, Clayton, Clinton, Crawford, Dallas, Delaware, Des Moines, Dickinson, Emmet, Franklin, Fremont, Greene, Hancock, Harrison, Henry, Howard, Humboldt, Ida, Johnson, Kossuth, Lee, Louisa, Lucas, Lyon, Madison, Marshall, Mills, Monona, Montgomery, Muscatine, O'Brien, Osceola, Page, Plymouth, Pocahontas, Pottawattamie, Ringgold, Sac, Scott, Shelby, Sioux, Story, Van Buren, Washington, Wayne, Webster, Winnebago, and Woodbury counties.

Melanoplus punctulatus griseus (Thomas)

1872 Caloptenus griseus Thomas, Rept. U.S. Geol. Surv. Mont. and Terr. 5:454.

1897 Melanoplus punctulatus Ball, Proc. Iowa Acad. Sci. 4:241.

1914 Melanoplus punctulatus Somes, Univ. Minn. Agr. Exp. Sta. Tech. Bull. No. 141, p. 94.

1915 Melanoplus punctulatus Somes, 15th Rept. St. Ent. Minn. p. 94.

1931 Melanoplus punctulatus Hebard, Proc. Acad. Nat. Sci. Phila. 83:181.

1935 Melanoplus punctulatus punctulatus Knutson and Jaques, Proc. Iowa Acad. Sci. 42:183.

Color above dark gray mottled with fuscous or black, underside much paler; postocular stripe broken to obsolete; tegmina sprinkled with numerous quadrate blackish spots which give mottled appearance; hind femora strongly banded on upper and outer faces with light and dark bands, underside and lower third of inner face bright coral red; hind tibiae dull red or gray or both and usually paler at base; metazona very finely rugose. Length of body, males, 19-24 mm.; females 27-29 mm.

This subspecies ranges from Maryland west to Minnesota and Nebraska and thence southward into Texas. It is a truly arboreal form, frequenting trees and most often clinging to the bark of the trunk or larger branches. This species and its two most closely related forms were treated by Rehn (113).

The earliest and latest seasonal dates available were July 22 and October 10. It is one of the less commonly encountered local Melanoplus.

Boone, Emmet, Fremont, Johnson, Plymouth, Story, and Woodbury counties.

Melanoplus gladstoni Scudder

1897 Melanoplus gladstoni Scudder, Proc. U.S. Nat. Mus. 20:229.

Grayish- to reddish-brown, postocular stripe interrupted; tegmina

with quadrate fuscous spots; hind femur gray to yellow-brown, banded on upper and usually outer faces with black; hind tibia almost wholly bright coral red; abdomen strongly marked with black on sides near base; pronotal disk widening posteriorly, its hind margin obtusely angled. Length of body, 18-25 mm.

M. gladstoni is known from the area from the Rocky Mountains east and north to Manitoba, Minnesota, and Iowa south to Kansas and Colorado. It is usually found in grasslands.

The moderately large series of Iowa specimens had been collected between July 13 and September 2. The records indicated that it probably occurs across the northern half of the state. Other state listings were given by Hebard (51, 57), Knutson and Jaques (86), and Knutson (85).

Dickinson, Emmet, Humboldt, Linn, Plymouth, Sioux, and Winneshiek counties.

Melanoplus infantilis Scudder

1879 Melanoplus infantilis Scudder, Proc. Boston Soc. Nat. Hist. 20:65.

Yellowish- to reddish-brown, paler beneath; postocular stripe slightly to greatly broken; tegmina with few or no quadrate black spots other than the row in the median area; hind femur yellowish, sometimes rather distinctly banded above and on outer face with fuscous or black; interocular width of head less than width of frontal costa. Length of body, 14-18 mm.

The general range of this grasshopper extends across southern Canada from Manitoba to British Columbia and south to Minnesota, Nebraska, Colorado, Wyoming, Idaho, and Washington. This is an inhabitant of areas of short, sparse grasses.

Hebard's (57) records for western Iowa formed the basis for Knutson and Jaques' (86) state listings. No Iowa specimens were available for study, the counties listed below having been taken from Hebard's above-cited work.

Lyon and Woodbury counties.

Melanoplus flavidus flavidus Scudder

1879 Melanoplus flavidus Scudder, Proc. Boston Soc. Nat. Hist. 20:74.

1920 Melanoplus flavidus Blatchley, Orthop. N.E. Am. p. 416.

Olive or yellowish-brown above, paler beneath; postocular stripe variable from distinct to subobsolete; tegmina with a vague, narrow pale median stripe which is sometimes spotted with fuscous; hind femur yellowish, upper and inner faces usually with two dark fuscous crossbars, the upper half of the outer face dusky; hind tibia blue, spines white with black tips. Length of body, 21-32 mm.

The known range of this form extends from Colorado north and northeast to South Dakota and Michigan and east through Kansas to central Illinois. Sand areas appear to form the preferred habitat of this species.

This species has been taken uncommonly in the adult stage between September 12 and October 20. Additional state listings have been given by Knutson and Jaques (86) and Knutson (85).

Johnson, Mills, and Muscatine counties.

Genus Phoetaliotes Scudder

1897 Phoetaliotes Scudder, Proc. Am. Acad. Arts and Sci. 22:202.

Head prominent, nearly half again as long as prozona; fastigium declivent, disk with a broad, elongate, depressed area; frontal costa narrowed above ocellus, variously sulcate around and below ocellus; prothorax slightly expanded anteriorly to receive head; its median carina low but distinct throughout, the principal sulcus cutting it behind the middle; tegmina variable, usually abbreviated, slightly longer than pronotum, their inner margins separated to slightly overlapping, apices acutely prolonged; tegmina rarely fully developed and then surpassing apices of abdomen and hind femora; latter reaching or surpassing tip of abdomen.

Genotype: Pezotettix nebrascensis Thomas.

The genotype, the only known member of the genus, occurs within the state.

Phoetaliotes nebrascensis (Thomas)

1872 Pezotettix nebrascensis Thomas, Prelim. Rept. U.S. Geol. Surv. Mont. and Terr. 5:455.

1892 Pezotettix nebrascensis Osborn, Proc. Iowa Acad. Sci. 1(2):117.

1897 Phoetaliotes (!) nebrascensis Ball, Proc. Iowa Acad. Sci. 4:241.

Color olive-green to gray with prominent black line from hind margin of eye along lateral lobe of pronotum to principal sulcus; hind femur usually with two vague, incomplete crossbars on upper inner face, lower face reddish-yellow; hind tibia buff, light green or glaucous; male cerci styliform. Length of body, 21-30 mm.

The range of this grasshopper spreads from Indiana north and west to North Dakota and Alberta, being absent in the Rocky Mountains and reappearing in British Columbia and northern California; and west and southwest to Iowa, Oklahoma, Texas, and Arizona. It occurs most abundantly on sparsely weeded sandy areas.

The species appears to be moderately common in the state. It was listed for Iowa by Scudder (92), Somes (145), Hebard (51), Hendrickson (70, 71), Knutson and Jaques (86), and Knutson (85), the latter giving the extremes of adult dates as July 20 and October 20. All other available dates fall within this range. A single long-winged male collected in Dickinson County on August 4, 1937 by Jaques is in the Survey Collection at Iowa Wesleyan College.

Buena Vista, Dickinson, Emmet, Fremont, Harrison, Lyon, Muscatine, Plymouth, Sioux, Story, Webster, and Woodbury counties.

Genus Dendrotettix Packard

1890 Dendrotettix Packard, Rept. U.S. Ent. Comm. 5:214.

Head large; fastigium widened, strongly deflexed, shallowly but distinctly concave; frontal costa wide, short, its lateral strongly converging and terminating just below ocellus; eyes subrounded, prominent, in height subequal to height of subocular suture pronotum strongly flared apically and above, hind margin truncate or broadly rounded, median carina present, strongly notched by three transverse sulci, the posterior two of which extend almost to lower margin of shallow lateral lobes, metazona

distinctly shorter than prozona, its dorsal surface coarsely rugose-punctate, lateral carinae absent; tegmina variable in form and length; hind femur nearly or quite reaching apex of abdomen.

Genotype: Dendrotettix quercus Packard.

Studies on the species of this genus were given by Rehn and Rehn (122, 123, 124). One of the species occurs in Iowa.

Dendrotettix quercus Packard

1890 Dendrotettix quercus Packard, Rept. U.S. Ent. Comm. 5:214.

Color yellow or yellow-green with piceous markings; most prominent of which are dark postocular stripe which becomes wider and darker on upper half of lateral lobes of pronotum, broad lateral stripe on abdomen, genital plates of male and hind knees; tegmina yellow-brown; outer face of hind femur sometimes with a vague fuscous crossbar at apical and basal thirds; tegmina usually abbreviated, not longer than pronotum, sometimes fully developed and extending beyond apex of abdomen; male cerci about twice as long as wide, apical halves twisted and depressed, tips obliquely rounded; furculae minute, triangular projections. Length of body, males, 20-25 mm.; females, 27-30 mm.

This tree-frequenting grasshopper ranges from Wisconsin (record in U.S.N.M. collection furnished by Gurney), Illinois, Iowa, and Kansas southwestward to east central Texas; there are also scattered, isolated colonies in New Jersey and New York. This is truly an arboreal form which frequents the trees in oak woods. Rehn and Rehn (214) wrote that this species "appears in waves of devastating local abundance separated by periods of virtually complete absence."

Literature records only are available for the local occurrence of D. quercus. These records were given by Scudder (136, 143), Hebard (55), and Rehn and Rehn (122, 124). It is probably confined to the southern part of the state where the rolling hills and wooded sections simulate the forest conditions farther south.

Genus Paratylotropidia Scudder

1897 Paratylotropidia Scudder,¹ Proc. U.S. Nat. Mus. 20:12.

Head not broader than pronotum, fastigium broad, slightly declivent, obsoletely impressed above, its apex rounded; eyes oval; frontal costa prominent, slightly sulcate above and below ocellus; pronotum with median and lateral carinae present, latter slightly bowed outward at middle, hind margin broadly, obtuse-angulate; tegmina short, at most slightly longer than wide; hind femora reaching or slightly surpassing apex of abdomen; interspace between mesosternal lobes much broader than long.

Genotype: Paratylotropidia brunneri Scudder.

Of the three known species treated by Rehn and Rehn (124a) only one occurs in Iowa.

Paratylotropidia brunneri Scudder

1897 Paratylotropidia brunneri Scudder, Proc. U.S. Nat. Mus. 20:118.

¹Rehn and Rehn (124a) followed on date for validity of this generic name.

Color above reddish-brown, paler beneath, with pair of prominent yellow lines extending from tip of vertex back above eyes, along pronotal carinae and dorso-lateral angle of tegmina; pronotum slightly tectate, median carina distinct on at least the prozona; tegmina lanceolate, longer than pronotum in brachypterous form, macropterous tegmina reaching or surpassing tips of hind femora; male cerci broadly flattened on basal half, strongly and evenly narrowing apically; furculae absent. Length of body, males, 29 mm.; females, 32-36 mm.

This species has been reported from South Dakota, Iowa, Illinois, Kansas, Arkansas, Oklahoma, and Texas.

A sizeable series of Iowa specimens has been collected by R.L. King. Among this material were both nymphs and adults, the former for May 26 to July 25 and the latter for the period from July 16 to October 11. This material furnished the basis for literature reports by Knutson and Jaques (86), Knutson (85), King (80), and Rehn and Rehn (124a), as well as the counties listed below.

Cedar, Davis, Des Moines, Henry, Iowa, Muscatine, Van Buren, and Woodbury counties.

Family TETTIGONIIDAE Stoll¹

1787 TETTIGONIAE Stoll, Spectres et Mantes, p. 1.

Head variable in shape from short and swollen to strongly produced conically; antennae filiform, many segmented; ocelli usually absent; tegmina and wings variably present or absent, when present varying from minute pads to elongate organs which greatly surpass apex of abdomen; wings may be longer or shorter than tegmina; front and middle legs slender, subequally developed; hind legs elongate, femora usually strongly swollen basally; all tarsi of four segments; ovipositor of four strongly compressed plates of valves, in profile usually sword-shaped or sickle-shaped, often toothed or serrate above and below near apex.

The habitats frequented by members of this family are quite diverse. The leaf-simulating green species are invariably plant inhabitants and may be found in woods or fields; the sombre brownish or yellowish ones usually frequent the ground where they hide under rocks, logs or other debris. The great majority of the species pass the winter as an egg. The eggs are laid in (sometimes on) stems, bark, or leaves of grasses, shrubs or trees, and in some cases they are inserted into the ground among the roots of the plants. The young individuals may be confused with short-winged adults but are separable therefrom by having the wing pads inverted and reversed in overlapping as in the *Acrididae*. Some of the species derive the greatest bulk of their food from plants, but will also avidly devour dead or incapacitated arthropods, even of their own species; while some of the *Decticinae* are nearly or wholly carnivorous. Just as in the *Acrididae*, the males of this family are equipped to perform a musical serenade for his prospective mate. Unlike the *Acrididae*, however, the sound-producing organs are located on the wings where they overlap above the insects' body. When the overlapping wings are gently rubbed

¹Correct author of name, vide Gurney (41); not Karny as given by Handlirsch (45) and others.

together certain roughened veins grate upon each other and produce the animal's "song." The females are incapable of producing this sound, but they, as well as the males, have "ears" or auditory organs on their front tibiae. Fulton (28) demonstrated the hearing function of these organs in males by amputating the front tibiae of specimens of certain species that normally synchronize their songs. After removal of the organ each individual sang independently of his neighbors. The song of each species is quite distinctive, the best known of which being the one that has so often been translated as saying. "Katy did!" Further information concerning the music of these insects may be found in the work of Fulton (32) and Pierce (103). Although not normally considered among the truly destructive insects because most of their nourishment comes from non-cultivated plants or plant surpluses, under certain conditions they have been known to cause appreciable damage to crops, especially in garden plots. Some of the above and additional notes on the habits of forms of this family that occur in Texas were given by Isely (75a).

Caudell (16) gave a key to the subfamilies of this group. Iowa's ten genera fall into five subfamilies which may be separated by the following key:

Key to the Subfamilies of TETTIGONIDAE in Iowa

1. Tegmina and wings present, sometimes brachypterous but then not hidden by hind part of pronotum 2
 Tegmina and wings absent or so short as to be almost wholly covered by prolonged hind margin of pronotum. DECTICINAE p. 294
2. Prosternum not spined; hind tibiae with an apical spine on both outer and inner sides PHANEROPTERINAE p. 274
 Prosternum with a pair of long, erect spines between front coxae; hind tibiae with apical spines absent or present on only one side. 3
3. Pronotum as long as broad, disk crossed by two deep, transverse sulci PSEUDOPHYLLINAE p. 281
 Pronotum longer than broad 4
4. Vertex produced anteriorly as a blunt cone with a prominent tooth below near base (Fig. 19) COPIPHORINAE p. 282
 Vertex much less produced, flattened apically, without a tooth below CONOCEPHALINAE p. 285

Subfamily PHANEROPTERINAE Brunner

1878 PHANEROPTERIDAE Brunner, K.K. Zool. - Bot. Gesells. Wien, 38:256.

Head short, face nearly or quite vertical; vertex variable, but never produced in front of eyes as cone or spine; pronotum short, with at most a faint median carina, disk flat or concave and usually narrowed anteriorly, posterior margin surpassing hind margin of perpendicular lateral lobes; tegmina and wings well-developed or brachypterous; hind legs much longer than other two pairs; male and female genitalia variable as to genus.

The majority of these katydids spend their entire lives on shrubs and trees, the leaves and tender branches of which furnish them with food. The short blunt ovipositor reflects the egg-laying habit which results in the eggs being glued in rows to the outside of leaves or twigs or within

the edges of leaves. These insects are chiefly night singers, their calls rarely being heard during the day.

Of the dozen genera known from the United States four occur in Iowa.

Key to the Genera of PHANEROPTERINAE in Iowa

1. Fastigium little if any wider than basal antennal segment . . . 2
Fastigium more than twice as wide as basal antennal segment . . . 3
2. Hind margin of pronotum produced as a distinct but rounded angle;
tegmina very narrow, less than twice as wide as hind femur.
. Arethaea p. 275
Hind margin of pronotum broadly rounded; tegmen broader, more
than four times as wide as hind femur Scudderia p. 276
3. Hind femur long, almost or quite reaching to apex of tegmina .
. Amblycorypha p. 279
Hind femur shorter, reaching not more than two-thirds of way to
apex of tegmina Microcentrum p. 279

Genus Arethaea Stal

1876 Arethaea Stal, Bihang. Svenska Akad. 4:55.

Fastigium narrow, sulcate, decurved to meet face; antennae set in widely margined sockets; eyes nearly twice as high as wide; pronotum saddle-shaped, disk rounding into lateral lobes, median carina obsolete, metazona with hind margin prolonged upwards; tegmina with costal area widened only on basal fifth; legs very long, hind pair nearly or quite four times as long as body, the tibia longer than femur, latter ending beneath at apex with a strong spine on each margin.

Genotype: Ephippitytha gracilipes Thomas.

The sixteen species known are all western hemisphere forms and were treated by Hebard (62). A single subspecies ranges as far north as Iowa.

Arethaea constricta constricta Brunner

1878 Arethaea constricta Brunner, Monogr. Phanerop. p. 236.

1930 Arethaea gracilipes constrictus Hendrickson, Ia. State Coll. Jour. Sci. 4:61.

Color green through greenish-brown to brown with apices of tegmina and wings green; fastigium conspicuously sulcate medially; eyes quite prominent, as high as subocular space; pronotum with length not quite twice greatest width; tegmina and wings fully or nearly fully developed; margins of abdomen not crenulate; length of body, 12.6-18.5 mm.

The present subspecies is the only member of this southwestern genus to range northward to any extent. It is known from Iowa and Nebraska south to Texas. Hebard wrote (55) that "The insect in these latitudes is apparently confined to the area between the typical Great Plains and the more humid eastern section." Its slender form and green color cause it to closely resemble the prairie grasses on which it lives.

In Iowa it has been found only in the westernmost tier of counties during late July and early August. Hendrickson (71) reported it as "quite common" in Andropogon scoparius-Bouteloua curtipendula associations.

Fremont, Plymouth, and Woodbury counties.

Genus Scudderia Stal

1873 Scudderia Stal, Ofv. Vet. Akad. Förh. 30(4):41.

Vertex horizontal, compressed, especially between the large, subglobose eyes; pronotal disk flat, meeting perpendicular lateral lobes at a distinct but rounded angle; all femora with an angled or spiniform projection on either side at apex; front coxa with a prominent deflexed spine on outer face.

Genotype: Locusta curvicauda DeGeer.

The eleven species treated by Rehn and Hebard (116) have been reduced to eight, five of which occur in Iowa.

Key to the Species of Scudderia in Iowa

1. Males (tip of abdomen without a strongly curved, compressed, sword-like ovipositor) 2
Females (tip of abdomen with such an ovipositor) 6
2. Last dorsal segment of abdomen subtriangular, without an elongate notched or bifurcate process at apex . . . S. septentrionalis p. 277
Last abdominal segment with an elongate, decurved median process which expands apically into two lobes or branches (Figs. 83-86). 3
3. Median process of last segment with a small triangular tooth at middle of quadrate apical notch (Fig. 86) . . . S. texensis p. 278
Median process of last segment not toothed in middle of notch . . . 4
4. Notch at apex of median process of last segment broadly V-shaped, the arms on either side markedly diverging (Figs. 84, 85) . . . 5
Notch at apex of median process of last segment U-shaped, the arms on either side parallel (Fig. 83) . . S. furcata furcata p. 278
5. Arms on either side of apical notch (viewed from above) broad, divergent lobes evenly transverse apically (Fig. 84)
. S. curvicauda curvicauda p. 277
Arms on either side of apical notch distinctly tapering to outer apex (Fig. 85) S. pistillata p. 277
6. Ovipositor more than one-and-a-half times as long as pronotum, with both upper and lower margins evenly curved, not bent S. septentrionalis p. 277
Ovipositor distinctly less than a time and a half as long as the pronotum 7
7. Ovipositor with an abrupt but rounded bend near basal third of upper margin, part beyond this sharply bent upward (Figs. 87, 90). 8
Ovipositor with upper margin gently bent near basal third, the upper margin appearing broadly and asymmetrically curved (Fig. 88) S. curvicauda curvicauda p. 277
8. Width of ovipositor near base distinctly greater than that at middle (Fig. 89) S. texensis p. 278
Width of ovipositor near base subequal to median width 9
9. Tegmina wide, costal area wider than the greatest thickness of hind femur; ovipositor abruptly bent upwards (Fig. 90)
. S. pistillata p. 277
Tegmina narrow, costal area about as wide as greatest thickness of hind femur; ovipositor not so abruptly bent (Fig. 87)
. S. furcata furcata p. 278

Scudderia septentrionalis (Serville)

1839 Phanoptera septentrionalis Serville, Hist. Nat. Ins. Orthop. p. 416.

Color bright green, often with head, anterior part of pronotum, bases of femora and underside of body yellow; tegmina strongly and coarsely reticulate. Length of body, males, 16-18 mm.; females, 18-20 mm.

This scarce species is known to occur from Maine to Virginia and west to Nebraska and Kansas. It is recorded as being a woods-frequenting species.

The several Iowa specimens at hand included three males taken during the period from June 22 to August 30 and one female collected in October. The species was listed for the state by Knutson and Jaques (86).

Clay, Dickinson, Henry, Humboldt, Johnson, Story, Winneshiek, Woodbury and Worth counties.

Scudderia curvicauda curvicauda (DeGeer)

1773 Locusta curvicauda De Geer, Mem. L'Hist. Nat. Ins. 3:446.

1876 Scudderia curvicauda Thomas, Proc. Dav. Acad. Nat. Sci. 1:262.

1877 Phanoptera curvicauda Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.

1892 Scudderia curvicauda Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Scudderia curvicauda Ball, Proc. Iowa Acad. Sci. 4:237.

1898 Scudderia curvicauda Scudder, Proc. Am. Acad. Arts. Sci. 33:279.

1925 Phanoptera curvicauda curvicauda Hebard, Proc. Acad. Nat. Sci. Phila. 77:126.

Color green, frequently yellowed on head, anterior part of pronotum, legs and underside of body; tegmina elongate, about five or more times as long as wide. Length of body, 18-25 mm.

The nominal race, the only one ranging into Iowa, occurs in a broad band across the northern United States from the Atlantic Ocean to Minnesota and Iowa and south to Kentucky. It is most frequently encountered in woods.

In Iowa this species appears to be not uncommon between July 18 and August 8. Other listings of the species for the state were given by Hebard (57) and Knutson and Jaques (86).

Appanoose, Dallas, Davis, Greene, Henry, Louisa, Muscatine, Van Buren, and Wayne counties.

Scudderia pistillata Brunner

1878 Scudderia pistillata Brunner, Monogr. der Phanopteriden, p. 240.

1925 Phanoptera pistillata Hebard, Proc. Acad. Nat. Sci. Phila. 77:125.

1928 Phanoptera pistillata Hebard, Ibid. 80:298.

Color green, underside, head and frequently anterior two pairs of legs yellow; tegmina very broad, its width at least one-fourth its length. Length of body, 19-20 mm.

In the longitude of the Mississippi Valley this boreal species ranges as far south as northern Illinois, Iowa, and Nebraska. Most recordings of habitat for this species indicates that it prefers shrubbery in damp situations.

In addition to the two records of Hebard's, cited above, the species was listed for the state by Osborn (98), Ball (2), Scudder (139), Hendrickson (70, 71), and Knutson and Jaques (86). Adult specimens had been collected during July and August.

Clay, Dickinson, Howard, Johnson, Plymouth, and Story counties.

Scudderia texensis Saussure and Pictet

1897 Scudderia texensis Saussure and Pictet, Biol. Centr. Am. Orthop., 1:330.

1892 (?) Scudderia furculata Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 (?) Scudderia furculata Ball, Proc. Iowa Acad. Sci. 4:237.

Color green, head, anterior part of thorax and underside of body frequently yellowed; tegmina longer, length at least five times the width. Length of body, 21-29 mm.

Southern Canada and the United States as far west as Ontario, Montana, Wyoming, and Texas are included in the range of this species. It occurs most abundantly in damp situations where it frequents shrubs and tall herbs.

Almost as common as its congener, S. furcata furcata, this species has been found as adult from July 20 until September 3. The two records of "Scudderia furculata" cited above (the name "furculata" is a synonym of S. mexicana (Saussure), a Mexican species known to occur north into the United States only in California, Arizona, and Texas) are probably correctly placed here. This is a common species locally and was undoubtedly included in the collections available to Osborn and Ball; however, since the current scientific name had not been established at that time, those authors probably misidentified it as indicated. Later literature records were given by Scudder (139), Hendrickson (71), and Knutson and Jaques (86).

Adams, Cherokee, Clarke, Clay, Davis, Dickinson, Emmet, Hancock, Hardin, Iowa, Jefferson, Johnson, Kossuth, Louisa, Palo Alto, Story, Van Buren, Warren, and Winnebago counties.

Scudderia furcata furcata Brunner

1878 Scudderia furcata Brunner, Monogr. der Phaneropteriden, p. 239.

1892 Scudderia furcata Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Scudderia furcata Ball, Proc. Iowa Acad. Sci. 4:237.

1930 Scudderia furcata Hendrickson, Iowa State Coll. Jour. Sci. 4:61.

Color dark or dull green, sometimes suffused with reddish-brown, body, and legs frequently yellowed; hind tibiae often purplish-brown; tegmina narrow, at least five times as long as broad, margins sub-parallel throughout length. Length of body, 15-31 mm. (Fig. 18).

The nominal race of the "forked-tail katydid" ranges widely in southern Canada and the eastern United States as far west as Ontario, the Dakotas, Nebraska, Texas, New Mexico, and Arizona. It appears to occur in all types of habitats except dense woods.

This is by far the most common Iowa species of Scudderia. It has been collected as adults between July 14 and October 5. Previous records for the state were given by Scudder (139) and Knutson and Jaques (86).

Appanoose, Boone, Clarke, Clay, Clayton, Davis, Des Moines, Dickinson, Emmet, Hardin, Harrison, Henry, Iowa, Johnson, Kossuth, Lee, Linn, Madison, Monroe, Muscatine, Polk, Scott, Sioux, Story, Van Buren, Wapello, Warren, Wayne, and Woodbury counties.

Genus Microcentrum Scudder

1862 Microcentrum Scudder, Boston Jour. Nat. Hist. 7:446.

Fastigium broad, faintly sulcate, evenly rounding to meet face; eyes subglobose; pronotal disk flat, meeting vertical lateral lobes at a distinct but rounded angle; hind margin of metazona broadly rounded; tegmina coriaceous, ovate-lanceolate, broadest at middle, costal area broad and prominent throughout much of its length; wings distinctly projecting beyond apices of tegmina; all femora spinose below; meso- and metasternals produced as oblique, elongate lobes.

Genotype: Steirodon thoracicus Serville.

There are four species of the genus known to occur within the United States; local records are available for one of them.

Microcentrum rhombifolium (Saussure)

1859 Phylloptera rhombifolium Saussure, Rev. et Mag. Zool. 11(2):204.

Color green (often fading to yellow in dried specimens), often yellowed ventrally and on head and anterior margin of pronotum; front margin of pronotum bisinuate with a more-or-less evident angulation or tooth at middle (Fig. 77); dorsal area of tegmina in both sexes closely and reticulately veined. Length of body, 25-30 mm.

The known range of M. rhombifolium is throughout the eastern United States as far north as New York, Indiana, Michigan, Wisconsin, and Nebraska while in the south it extends westward to the Pacific Coast. This is a bush- or shrub-inhabiting form.

The specimens studied were collected during the period from June 24 to October 6, and indicated that the species is restricted to the southern half of the state. Knutson and Jaques (86) listed it for the state.

Des Moines, Henry, Jefferson, Johnson, Linn, Louisa, Muscatine, Page, Polk, Scott, Story, and Washington counties.

Genus Amblycorypha Stål

1873 Amblycorypha Stål, Ofv. Vet. Akad. Förrh. 30(4):40.

Fastigium flat, more than twice as broad as basal antennal segment, roundly deflexed to meet face; eyes elliptical or oblong-oval; pronotum with disk flat, meeting lateral lobes at a distinct angle for most of their length; tegmina usually shorter than wings, widest at middle, costal area broad throughout most of its length.

Genotype: Locusta oblongifolia DeGeer.

Three of the seven species recognized from North America are known to occur within Iowa.

Key to the Species of Amblycorypha in Iowa

1. Humeral sinus of lateral lobe of pronotum very weak, broadly and smoothly rounded A. rotundifolia p. 280

- Humeral sinus deep, abrupt, the hind margin of the lateral lobes almost at right angles to margin of metazona (Fig. 78) . . . 2
2. Hind femur not surpassing apex of tegmina, latter shorter than the wings A. oblongifolia p. 280
- Hind femur distinctly surpassing apex of tegmina, latter slightly longer than wings; tegmina less than 30 mm. in length. A. parvipennis p. 280

Amblycorypha rotundifolia (Scudder)

1862 Phylloptera rotundifolia Scudder, Boston Jour. Nat. Hist. 7:445.

Color green, abdomen and legs usually in part yellow or tan; pronotum with lateral carinae evident but rounded on posterior two-thirds; tegmina shorter than wings. Length of body 19-20 mm.

The known range of this species is southeastern, extending northwest to Minnesota. It is to be found on the ground among or on grasses or weeds, especially in moist ravines.

No specimens were available for study, but literature records without localities have been given by Osborn (98), Ball (2), and Knutson and Jaques (86). It probably is restricted to the eastern half or less of the state.

Amblycorypha oblongifolia (DeGeer)

1773 Locusta oblongifolia DeGeer, Mem. L'Hist. Nat. Ins. 3:445.

Color bright green, dorsal area of tegmina frequently brown, abdomen and front and middle legs often yellowed; pronotal disk flat, lateral carinae less distinct on apical third; stridular area of male tegmina greater than disk of pronotum; subgenital plate with a V-shaped median emargination apically; ovipositor regularly and evenly curved, margins strongly serrate. Length of body, 21-25 mm.

The range extends across southern Canada and the United States west to Ontario, South Dakota, and Kansas and south to North Carolina, Louisiana, and Texas. This "katydid" occurs most frequently on weeds and shrubs, especially in damp situations along fence rows and in edgegrowth of woods or hedges.

One specimen from Fremont County has the pronotal disk blackish-brown and the tegmina yellow brown with bold fuscous spots. Local specimens were collected during the period from July 6 to October 16. Iowa records were given by Osborn (98), Ball (2), Rehn and Hebard (114), and Knutson and Jaques (86).

Appanoose, Boone, Bremer, Cass, Clayton, Dallas, Dickinson, Fremont, Henry, Lee, Linn, Louisa, Muscatine, Polk, Story, Van Buren, and Woodbury counties.

Amblycorypha parvipennis Stal

1876 Amblycorypha parvipennis Stal, Bihang. Svenska Akad. 4(5):58.

1897 Amblycorypha brachyptera Ball, Proc. Iowa Acad. Sci. 4:237.

1914 Amblycorypha rotundifolia iselyi Rehn and Hebard, Trans. Am. Ent. Soc. 40:337.

1925 Amblycorypha rotundifolia iselyi Hebard, Proc. Acad. Nat. Sci. Phila. 77:128.

1930 Amblycorypha rotundifolia brachyptera Hendrickson, Ia. State Coll. Jour. Sci. 4:61.

Color green, underside and legs frequently yellowed; tegmina not quite three times as long as wide. Length of body, 17-27 mm.

A. parvipennis was stated by Hebard (69) to be a distinct "midwestern species;" it has been reported for South Dakota, Iowa, Kansas, Missouri, and Texas.

This species, of which Ball (2) described the synonymous A. brachyptera from Iowa, is a frequenter of grasslands and was encountered and recorded as "not numerous" by Hendrickson (71) in his Iowa prairie studies. Available records of adults are encompassed with the seasonal extremes of July 8 and August 31.

Black Hawk, Cherokee, Dallas, Dickinson, Hamilton, Iowa, Kossuth, Lyon, Story, Winnebago, and Worth counties.

Subfamily PSEUDOPHYLLINAE Brunner

1893 PSEUDOPHYLLIDAE Brunner, Ann. Mus. Civ. Stor. Nat. Genova, 33:165.

Head very broad with fastigium acute and strongly narrowed by antennal insertions; eyes small, subglobose, widely separated; pronotum saddle-shaped, lateral carina obsolete or absent, hind margin broadly rounded; tegmina very broad, strongly convex, costal area broad with numerous straight parallel veins, dorsal area short and triangular; meso- and metasterna not lobed; all tibiae sulcate, spined beneath; first two segments of hind tarsus longitudinally sulcate laterally.

The true katydids are strictly arboreal, seeking shelter and food in the foliage of the tallest trees and shrubs available. Consequently they are seldom seen even though they may and sometimes do occur in great numbers. Even the eggs are laid high up in the trees where they are thrust into crevices in the loose bark.

Three genera of this subfamily occur in the United States; one of them has been collected in Iowa.

Genus Pterophylla Kirby

1828 Pterophylla Kirby, Intro. Entom. Edit. 5, 2:218.

Lateral carinae of pronotum indicated only on metazona; front tibia unarmed above; middle coxa with a tubercle on inner face.

Genotype: Locusta camellifolia Fabricius.

One species of this genus, which was treated by Hebard (66), has been collected in the state.

Pterophylla camellifolia camellifolia (Fabricius)

1775 Locusta camellifolia Fabricius, Syst. Entom. p. 283.

1876 Cyrtophyllus concavus Thomas, Proc. Davenport Acad. Nat. Sci. 1:262.

1877 Cyrtophyllum concavum Bessey, 7th Bienn. Rept. Iowa State Coll. p. 206.

1892 Cyrtophyllus concavus Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Platyphyllum concavum Ball, Proc. Iowa Acad. Sci. 4:237.

1906 Cyrtophyllus perspicillatus Caudell, Jour. N.Y. Ent. Soc. 14:

Color yellowish-green, tegmina usually distinctly dark green, tympanal area of male brownish; pronotal disk densely punctate, pro- and metazona subequal in length, lateral lobes with lower angles rounded; tegmina with posterior margins curved, distinctly overlapping. Length of body, 25-34 mm. (Fig. 15).

Nominal camellifolia, the only member of the genus to occur in the state, inhabits the eastern United States as far west as Kansas and Oklahoma and north to Michigan and Ontario in southern Canada. It frequents the denser foliage of vines, fence rows and the higher branches of trees, particularly oaks and elms. This habit of hiding among denser foliage and higher up in trees results in very few specimens finding their way into collections.

In spite of the fact that this "katydid" probably occurs in appropriate tree habitats over most of the state, only a limited number of specimens were available for study. These had been collected between July 20 and September 20, with one nymph dated July 13. It was listed for the state by Knutson and Jaques (86).

Buena Vista, Cedar, Delaware, Hardin, Henry, Johnson, Linn, Marion, Story, Van Buren, and Worth counties.

Subfamily COPIPHORINAE Caudell

1910 COPIPHORINAE Caudell, Proc. Ent. Soc. Washington, 12:96.

Fastigium prolonged forward as a blunt or acute cone, its lower side usually bearing a blunt or sharp tooth near base; eyes small; tegmina and wings usually (always in our species) fully developed; front coxa with a spine on outer face; hind femur strongly swollen basally; hind tibia with two rows of spines on posterior face.

The Iowa representatives of this subfamily frequent the denser stands of grasses and reeds, both in dry fields and along bodies of water, but are not entirely absent from stands of forbs. They insert their eggs among the lower leaves and roots of grasses on which they live. Their "song" is rather loud though unmusical and produced most actively after dark.

A single genus of the "cone-headed katydids," which were treated by Karny (76), is represented in Iowa by four species.

Genus Neoconocephalus Karny

1907 Neoconocephalus Karny, Abh. Zool.-Bot. Gessells. Wien, 4(3):22.

Fastigium produced as a prominent conical structure with a tooth beneath near base; pronotal disk about twice as long as broad, its sides feebly diverging posteriorly; lateral lobes of pronotum about as deep as broad, their lower margins rounded; tegmina long, narrow, rounded apically and slightly longer than wings, both much surpassing apex of abdomen; ovipositor narrow, elongate, sometimes being considerably longer than the length of the body. The color is generally green but reddish-brown individuals are sometimes found.

Genotype: Conocephalus subulatus Bolivar.

Of the elevenspecies treated by Rehn and Hebard (118) as occurring north of Mexico, four have been found in Iowa.

Key to the Species of Neoconocephalus in Iowa

1. Underside of conically produced fastigium unicolorous pale, not marked with black N. robustus p. 283
 Underside of conically produced fastigium distinctly marked with black 2
2. Fastigium, from above, distinctly longer than wide, its apex narrowly rounded (Figs. 103, 105) 3
 Fastigium, from above, at most but slightly longer than wide, its apex broadly rounded (Fig. 104) N. retusus p. 285
3. Fastigium below margined apically and laterally with a narrow black line N. ensiger p. 284
 Fastigium with ventral surface black to or including basal tooth N. nebrascensis p. 284

Neoconocephalus robustus (Scudder)

1862 Conocephalus robustus Scudder, Boston Jour. Nat. Hist. 7:449.

Color green, rarely brown, underside, sides of fastigium and lateral carinae of pronotum yellow; cone of fastigium distinctly longer than broad, its apex narrowly rounded; pronotal disk becoming more closely punctured posteriorly; ovipositor subequal in length to hind femur. Length of body, 30-40 mm.

The range of this species is from Massachusetts south to Florida and west to Minnesota, Kansas, and Texas. The habitat is apparently that furnished by weedy sandy fields. This species breaks into two races which may be separated by the following key:

Key to the Subspecies of Neoconocephalus robustus in Iowa

1. Fastigium gently and evenly narrowed from base, in profile usually longer and somewhat attenuate . . . N. robustus robustus p. 283
 Fastigium becoming more abruptly narrowed in middle third (Fig. 103), in profile somewhat shorter and stouter . . .
 N. robustus crepitans p. 284

Neoconocephalus robustus robustus (Scudder)

1862 Conocephalus robustus Scudder, Boston Jour. Nat. Hist. 7:449.

The nominal race occurs typically only in the northeastern United States along the Atlantic Coast but ranges inland across the northern states as far as Iowa in an atypical form.

Only two Iowa specimens of this race were studied. Both of them were in the Iowa Insect Survey Collection, one of them identified by Hebard. They had been collected in Davis and Page counties on the southern border of the state and apparently formed the basis for the record by Knutson and Jaques (86).

Neoconocephalus robustus crepitans (Scudder)

- 1862 Conocephalus crepitans Scudder, Boston Jour. Nat. Hist. 7:450.
 1892 Conocephalus crepitans Osborn, Proc. Iowa Acad. Sci. 1(2):119.
 1897 Conocephalus crepitans Ball, Proc. Iowa Acad. Sci. 4:237.
 1900 Conocephalus crepitans Scudder, Proc. Dav. Acad. Nat. Hist. 8:72.

The race N. robustus crepitans (Fig. 19) occupies the southern part of the species range as outlined above, ranging as far as northern Indiana, Illinois, Iowa, and Kansas.

A moderate number of specimens were available for study, some of them having been collected at lights. The adults extended over the period from August 1 to October 25, while one mature nymph was labelled for July 28. Knutson and Jaques (86) also listed the race for the state.

Buchanan, Clarke, Henry, Johnson, Lee, Monona, Muscatine, Page, Story, and Van Buren counties.

Neoconocephalus ensiger (Harris)

- 1841 Conocephalus ensiger Harris, Rept. Ins. Mass. p. 131.
 1877 Conocephalus ensiger Bessey, 7th Bienn. Rept. Iowa State Coll. p. 207.
 1892 Conocephalus ensiger Osborn, Proc. Iowa Acad. Sci. 1(2):119.
 1892 Conocephalus attenuatus Osborn, Proc. Iowa Acad. Sci. 1(2):119.
 1897 Conocephalus ensiger Ball, Proc. Iowa Acad. Sci. 4:237.
 1897 Conocephalus attenuatus Ball, Proc. Iowa Acad. Sci. 4:237.

Color green or brown, lines extending from tip of vertex back along lateral carinae of pronotum yellow or brown; disk of pronotum becoming more finely and densely punctured on metazona; outer lower margin of hind femur usually not spined; ovipositor longer than the hind femur. Length of body, males, 24-26 mm.; females, 28-30 mm.

The most widely distributed member of the genus, N. ensiger is known to occur in southern Canada and the northern United States as far west as Ontario, North Dakota, Colorado, and south to North Carolina, Tennessee, Kansas, and New Mexico. It inhabits clumps of prairie grasses, like Andropogon, in dry sandy prairies.

The more than fifty specimens in the collection of Iowa State College indicate that this is a fairly common species, at least in the central part of the state. Some of them were nearly mature nymphs which had been collected during July; the remainder consisted of adults with dates from July 7 to September 17. This insect was also listed for the state by Rehn and Hebard (118), Hendrickson (70, 71), and Knutson and Jaques (86).

Black Hawk, Dallas, Davis, Dickinson, Emmet, Iowa, Johnson, Kosuth, Lyon, Page, Plymouth, Polk, Sioux, Story, Van Buren, and Woodbury counties.

Neoconocephalus nebrascensis (Bruner)

- 1891 Conocephalus nebrascensis Bruner, Canadian Ent. 23:72.
 1892 Conocephalus nebrascensis Osborn, Proc. Ia. Acad. Sci. 1(2):119.
 1897 Conocephalus nebrascensis Ball, Proc. Iowa Acad. Sci. 4:237.

Color green, tan or brown, usually with pale stripe from tip of vertex back along lateral carinae of pronotum, and sometimes with a postocular

stripe from hind margin of eye obliquely down and back across lateral lobe of pronotum; fastigium much longer than broad, tip narrowly rounded; hind femur spined below on both margins; ovipositor distinctly longer than hind femur. Length of body, males, 33-37 mm.; females, 38-44 mm.

N. nebrascensis occurs across southern Canada and the United States as far west as Nebraska and Kansas and south to Tennessee and Arkansas. It is to be found among tall coarse grasses on dry prairies.

This species was described (loc. cit.) in part from Iowa material. The five specimens available for this study were all males and had been caught in the vicinity of Ames, Story County; only one bore a date label—for August 1. In four specimens of this series the fastigial tooth showed only faint darkening. Knutson and Jaques (86) listed it for the state.

Neoconocephalus retusus (Scudder)

1879 Conocephalus retusus Scudder, Proc. Boston Soc. Nat. Hist. 20:93.

Color green or pale brown, lateral carinae of pronotum often yellowish; pronotum coarsely and thickly punctate; hind femur spined below on both carinae; ovipositor much longer than hind femur. Length of body, males, 26-28 mm.; females, 29-31 mm.

The known range of this orthopteron extends from Connecticut south to Florida and west to Iowa and Missouri. It has been reported as frequenting lush stands of grasses on marshy grounds.

The only available record was from a specimen in the Iowa Insect Survey Collection which apparently served as the basis for the listing given by Knutson and Jaques (86). The specimen bore the label data "Mt. Pleasant, Iowa, Sept. 29, 1935."

Subfamily CONOCEPHALINAE

1874 CONOCEPHALIDAE Stal, Recensio Orthop. 2:97.

Vertex projecting forward and upward as a blunt, rounded process, excavated either side to receive antennal insertions; eyes moderate in size, subglobose; tegmina variable in length and development, even within same species; wings reflecting degree of development of tegmina but sometimes even longer; general color green, often marked with brown or red.

In general, the species of this group simulate the foliage of the herbaceous plants which they frequent. The elongate pointed ovipositor is used to make openings in the ground or tissues of plants for the reception of the eggs. These insects are capable of producing two types of calls, one normally being given during the day and the other at night.

Karny (77) treated this subfamily. Two very closely allied genera occur in Iowa.

Key to the Genera of CONOCEPHALINAE in Iowa

1. Males with subgenital plate distinctly emarginate; females with ovipositor stout, not of uniform depth and usually distinctly upcurved apically; tegmina (in our species) always fully developed Orchelimum p. 286

Males with subgenital plate almost truncate; females with ovipositor slender, straight, of uniform depth; tegmina and wings either fully developed or abbreviated . . . Conocephalus p. 290

Genus Orchelimum Serville

1839 Orchelimum Serville, Hist. Nat. des Ins. Orthop. p. 522.

Face moderately oblique; pronotum short, usually smooth, saddle-shaped; lateral lobes of pronotum deeper than long, hind margin broadly rounded into lower margin; tegmina narrow, usually strongly tapering, almost always shorter than wings; spines of prosternum long, slender, cylindrical; all femora unarmed beneath or hind pair with a few spines.

Genotype: Orchelimum cuticulare Serville.

Six of the seventeen species recognized from North America by Rehn and Hebard (119) have been found in Iowa.

Key to the Species of Orchelimum in Iowa

1. Males (tip of abdomen without elongate, sword-like ovipositor). . . 2
Females (tip of abdomen with elongate, sword-like ovipositor). . . 7
2. Cercus with part of shaft beyond tooth not longer than basal part (Figs. 92, 96). 3
Cercus with part of shaft beyond tooth longer than basal part (Figs. 94, 95). 6
3. Inner tooth of cercus distinctly longer than apical part of shaft (Fig. 92); lower outer margin of hind femur with several distinct spines O. silvaticum p. 288
Inner tooth of cercus not longer than apical part of shaft (Fig. 91). . . 4
4. Upper surface without a strong, sharp, sinuate, longitudinal carina. . 5
Upper surface of cercus with a strong, sharp, sinuate, longitudinal carina (Fig. 96); inner tooth of cercus strongly inclined toward base of cercus O. nigripes p. 288
5. Humeral sinus of lateral pronotal lobes marked by a strong emargination; inner tooth of cercus not as long as apical part of shaft (Fig. 91). O. vulgare p. 287
Humeral sinus of lateral pronotal lobes indicated by a weak sinuation; inner tooth of cercus as long as apical part of shaft (Fig. 93). O. gladiator p. 287
6. Apical part of cercal shaft tapering unevenly to narrowly rounded tip (Fig. 95); hind femora rarely spined on ventral margin (see p. 289 for key to subspecies) O. concinnum p. 289
Apical part of cercal shaft tapering evenly to very acute tip (Fig. 94); hind femora with ventral margins spined. O. volantum p. 290
7. Upper edge of ovipositor wholly or in great part straight; lower margin arcuate, the greatest width near middle (Fig. 82). 8
Upper edge of ovipositor regularly and decidedly curved (Fig. 81). . . 9
8. Ovipositor less than two-thirds length of hind femur O. volantum p. 290
Ovipositor at least two thirds as long as hind femur O. gladiator p. 287

9. At least hind tibiae (usually all of them) strongly blackened above; ovipositor strongly curved, more than half as long as hind femur. O. nigripes p. 288
Tibia not blackened above 10
10. Hind femur always spined on outer lower margin; humeral sinus indicated by a weak sinuation O. silvaticum p. 288
Hind femur rarely spined below; humeral sinus obvious. . . 11
11. Fastigium broad, as wide as basal segment of antenna; lateral lobes of pronotum as long as deep. O. vulgare p. 287
Fastigium narrower, not as wide as basal segment of antenna; lateral lobes of pronotum as long as deep. . O. concinnum p. 289

Orchelimum vulgare Harris

1841 Orchelimum vulgare Harris, Rept. Ins. Mass. p. 130.

Color green to reddish-brown, dorsum of head and pronotum with a broad reddish-brown stripe which widens posteriorly and is usually dark-margined on the pronotum; tegmina of male with a pair of elongate black spots on dorsal field; pronotum elongate, the metazona but slightly turned; lateral lobes longer than deep, lower posterior margin inflexed by strongly developed, convex callosity; tegmina almost or quite reaching apex of wings, sometimes slightly surpassing them and usually equalling or slightly extending beyond apex of hind femora; latter usually unarmed beneath, rarely (in no Iowa material) with one or two spines on outer lower margin. Length of body, 18-23 mm.

O. vulgare has the widest distribution of any of the North American species of the genus, its range extends across southern Canada from Quebec to Ontario and thence south to North Carolina, Georgia, Arkansas, and Texas. It frequents upland fields as well as lowland meadows.

Many state records were given in literature, all of them apparently based on specimen records; Bessey (6), Osborn (98), Ball (2), Rehn and Hebard (119), Hendrickson (70, 71), and Knutson and Jaques (86). In his prairie studies Hendrickson reported that "most of the specimens were taken at Spartina consocias." Adult records are for the period from July 20 to September 15.

Appanoose, Audubon, Calhoun, Clay, Crawford, Dallas, Davis, Decatur, Dickinson, Fremont, Guthrie, Henry, Humboldt, Iowa, Jefferson, Johnson, Keokuk, Lee, Louisa, Lyon, Monona, Muscatine, Linn, Palo Alto, Plymouth, Polk, Sioux, Story, Taylor, Van Buren, Warren, Wayne, and Woodbury counties.

Orchelimum gladiator Bruner

1891 Orchelimum gladiator Bruner, Canadian Ent. 23:71.

Pale green, tegmina quite hyaline, broad dark stripe on dorsum of head and pronotum may be absent or present; pronotum elongate, metazona noticeably upturned; lateral lobes deeper than long, humeral sinus very weak or obsolete; tegmina usually slightly surpassing both wings and femora; hind femur not spined beneath. Length of body, 17-20 mm.

In the central United States the range, which extends across southern Canada and the northern United States, is known to push as far south as Tennessee and Kansas. It is most often found in damp prairies and meadows.

This species was reported for the state by Rehn and Hebard (119), Hebard (53), Hendrickson (71), and Knutson and Jaques (86). The material studied during preparation of this paper had been collected between July 2 and August 12.

Dallas, Dickinson, Hamilton, Hancock, Henry, Polk, and Story counties.

Orchelimum nigripes Scudder

1875 Orchelimum nigripes Scudder, Proc. Boston Soc. Nat. Hist. 17:459.

Color green or reddish-brown, broad dark stripe of upper head and pronotum sometimes absent, front and middle femora usually yellowish, hind pair green with apical third frequently embrowned or blackened; tibiae variable from all entirely black to pale with only upper surface of hind pair blackened; pronotum short, metazona markedly elevated, lateral lobes deeper than long, humeral sinus moderate; tegmina usually nearly or quite reaching or surpassing apices of wings and hind femora; latter armed on outer lower margin with one to four small spines. Length of body, 18-21 mm.

The more limited range of this species occupies the area from Ontario south and west to Louisiana, Colorado, and Texas. Within this area the species is to be found most commonly among the lush vegetation of grasses and reeds which grow adjacent to ponds, streams and other bodies of water.

Specimens have been collected commonly between July 24 and October 18 in the same type of habitat in Iowa. In addition, the species was found to occur commonly in corn fields. There it was observed to feed, not on the corn plants themselves but on the pollen that blanketed the leaves and the ground. Osborn (98), Ball (2), Rehn and Hebard (119), Hendrickson (71), and Knutson and Jaques (86), all recorded it for the state.

Appanoose, Boone, Dickinson, Hamilton, Henry, Iowa, Jackson, Johnson, Muscatine, Polk, Story, Van Buren, Wapello, Washington, and Woodbury counties.

Orchelimum silvaticum McNeill

1891 Orchelimum silvaticum McNeill, Psyche, 6:26.

Color pale green, usually with the dark stripe of vertex and pronotum present; fastigium feebly ascending; pronotum with metazona two-thirds as long as prozona and slightly upturned; lateral lobes longer than deep; humeral sinus scarcely evident; tegmina reaching or surpassing tips of wings and hind femora; latter armed on outer lower margin with three or four spines. Length of body, 19-23 mm.

The range of this more southwestern species extends from Illinois and Tennessee west and southwest to Colorado and Texas. It frequents a variety of situations, including grassy fields and woods.

State records are given by Hebard (59) and Knutson and Jaques (86). The small series available for study was collected between July 23 and October 11.

Boone, Cedar, Dickinson, Henry, Plymouth, Story, and Woodbury counties.

Orchelimum concinnum Scudder

- 1862 Orchelimum concinnum Scudder, Boston Jour. Nat. Hist. 7:452.
 1892 Xiphidium longipennis Osborn, Proc. Iowa Acad. Sci. 1(2):119.
 1900 Orchelimum longipenne Scudder, Proc. Dav. Acad. Nat. Sci. 8:74.
 1930 Orchelimum concinnum Hendrickson, Ia. State Coll. Jour. Sci. 4:62.

Color green, tegmina frequently translucent red or reddish-brown, dorsal stripe of head and pronotum usually present, face (in local specimens) not marked with a dark median stripe; fastigium not or very feebly ascending; pronotum with metazona not or very feebly upturned, lateral lobes deeper than long; tegmina slightly shorter than wings but surpassing apex of hind femur; latter rarely spined beneath. Length of body, 16.5—18 mm.

The range of O. concinnum extends from New England and Ontario west to Minnesota and South Dakota and south to southwest Florida, Texas, and New Mexico. Specimens are encountered most frequently under moist prairie or meadow conditions. Two races of this species are recognized by characters shown only in the female, as indicated by the key given below. The limited data available indicated that both races may be found throughout the state.

Key to the Subspecies of Orchelimum concinnum in Iowa

1. Ovipositor not more than half as long as hind femur
 O. concinnum concinnum p. 289
 Ovipositor considerably more than half as long as hind femur . .
 O. concinnum delicatum p. 289

Because the distribution of the races given below is based exclusively on females it does not indicate the known range of the species within the state. Therefore, the composite range, based on records of both sexes, has been given first, with the treatment of each subspecies following.

Black Hawk, Boone, Carroll, Clay, Dallas, Davis, Dickinson, Fremont, Hamilton, Harrison, Johnson, Kossuth, Linn, Palo Alto, Ringgold, Story, Webster, and Woodbury counties.

Orchelimum concinnum concinnum Scudder

- 1862 Orchelimum concinnum Scudder, Boston Jour. Nat. Hist. 7:452.

This race occurs in the area outlined above except that it is not known from South Dakota and western Minnesota. Local material bore date labels for the period from August 1 to October 12.

Carroll, Davis, Dickinson, Hamilton, and Story counties.

Orchelimum concinnum delicatum Bruner

- 1892 Orchelimum delicatum Bruner, Ent. News, 3:265.

The western part of the species' range from Indiana and Minnesota west to South Dakota, Nebraska, and Kansas is occupied by both races simultaneously or the present one alone. July 25 and August 8 were the extremes of dates shown by specimens.

Black Hawk, Clay, Dallas, Dickinson, Palo Alto, and Woodbury counties.

Orchelimum volantum McNeill

1891 Orchelimum volantum McNeill, *Psyche* 6:266.

Color pale brownish-green, occiput and pronotum usually with a pair of feebly diverging dark lines; fastigium moderately ascending; pronotum short, metazona slightly upturned, lateral lobes deeper than long, humeral sinus broad and shallow; tegmina reaching apices of wings, feebly surpassing tips of hind femora; latter armed beneath on outer margin with one to four stout spines. Length of body, 17-25 mm.

The range of O. volantum is restricted to the area from Ontario and Ohio west to Nebraska and south to central Indiana and Illinois. Its preferred habitat is among weeds that grow out of water. Of its habits Hebard (59) wrote: "It is usually possible to secure specimens only from a boat or by wading in waist-deep water."

State records were given by Rehn and Hebard (119) and Knutson and Jaques (86), the latter apparently based on a specimen in the Iowa Insect Survey Collection labeled "Iowa City, Iowa, Shimek" and so determined by Hebard.

Cedar and Iowa counties.

Genus Conocephalus Thunberg

1815 Conocephalus Thunberg, *Mem. Acad. Impt. Soc. St. Petersburg*, 5:271.

Included species very similar to those of Orchelimum, differing chiefly in characters indicated in key to genera; tegmina and wings usually abbreviated, only occasionally fully developed except in C. fasciatus where they are always full length; tooth of male cercus not set in a socket.

Genotype: Conocephalus hemipterus Thunberg.

Of the sixteen North American species recognized by Rehn and Hebard (120) seven have been taken in Iowa.

Key to the Species of Conocephalus in Iowa

1. Hind tibia with three pairs of spines at apex 2
Hind tibia with one spine on either side at apex . . . C. saltans p. 294
2. Males (tip of abdomen without ovipositor). 3
Females (tip of abdomen with compressed, sword-shaped
ovipositor) 8
3. Cercus armed on inner side with a stout tooth, the base of which
is plainly visible from above (Figs. 97, 100). 4
Cercus armed on inner side with a stout tooth, the base of which
is not visible from above (Figs. 98, 102) 7
4. Apical part of cercus strongly depressed, broad and sometimes
rounded at apex (Figs. 97, 98) 5
Apical part of cercus at most gently depressed, tapering toward
apex (Figs. 100, 101) 6
5. Depressed part of cercus horizontal or flat (Fig. 99)
. C. fasciatus fasciatus p. 291
Depressed apical part of cercus oblique, more strongly depressed
on inner side (Fig. 97) C. brevipennis p. 292

6. Cercus slender, elongate, at least four times as long as basal diameter (Fig. 101) C. strictus p. 293
Cercus shorter, broader, about three times as long as basal diameter (Fig. 100) C. nemoralis p. 292
7. Abdomen nearly wholly shining black. C. nigropleurum p. 293
Entire abdomen brown, tan or yellowed C. attenuatus p. 293
8. Sides of abdomen shining black C. nigropleurum p. 293
Sides of abdomen brownish or tan 9
9. Ovipositor at least 1.5 times as long as body, curved only near base. 10
Ovipositor not or but slightly longer than body, straight or curved. 11
10. Vertex (in profile) strongly ascending on anterior third or more (Fig. 106); tegmina in brachypterous forms almost twice as long as pronotum C. attenuatus p. 293
Vertex horizontal or only faintly ascending anteriorly; tegmina of brachypterous forms not longer than pronotum. . C. strictus p. 293
11. Tegmina and wings always fully developed and reaching or surpassing apex of hind femur C. fasciatus fasciatus p. 291
Tegmina and wings (in all available specimens) abbreviated, not reaching tip of hind femur 12
12. Tegmina showing a variable dark blotch at middle of sutural margins C. nemoralis p. 292
Tegmina without a dark blotch on sutural margin C. brevipennis p. 292

Conocephalus fasciatus fasciatus (DeGeer)

- 1773 Locusta fasciata DeGeer, Mem. Hist. Nat. Ins. 3:458.
1877 Xiphidium fasciatum Bessey, 7th Bienn. Rept. Ia. State Coll. p. 207.
1892 Xiphidium fasciatum Osborn, Proc. Iowa Acad. Sci. 1(2):118.
1897 Xiphidium fasciatum Ball, Proc. Iowa Acad. Sci. 4:238.

General color green with broad brown stripe from tip of vertex back over pronotum and along top of abdomen, abdomen also with a pair of more-or-less distinct dorso-lateral stripes of the same color; fastigium not ascending, broadest anteriorly; lateral pronotal lobes deeper than long; tegmina slightly shorter than wings but always passing tips of hind femora; latter rarely spined beneath; prosternum with a pair of long slender spines. Length of body, 12-14.5 mm.

C. fasciatus fasciatus, the only race of this species known to occur in Iowa, ranges from New England and Nova Scotia west to Manitoba, Wyoming and New Mexico, south to Florida, Bermuda, and northern Mexico. It is especially abundant in lush meadows and on low ground along streams.

Later literature records for the state are by Rehn and Hebard (120), Hendrickson (71), and Knutson and Jaques (86). Hendrickson found it at Andropogon furcatus-Spartina michauxiana associates and reported it as "more common where grasses are taller." The large number of specimens examined were collected between the dates of July 18 and October 17, indicating that the adults probably remain active until killed by frost.

Audubon, Benton, Black Hawk, Boone, Buchanan, Buena Vista, Calhoun, Cherokee, Clay, Clayton, Dallas, Davis, Dickinson, Franklin, Grundy, Hamilton, Hancock, Harrison, Henry, Howard, Iowa, Jasper, Jefferson, Johnson, Keokuk, Kossuth, Lucas, Lyon, Marshall, Mills, Mitchell, Monona, Monroe, Muscatine, O'Brien, Page, Palo Alto, Plymouth, Polk, Sac,

Sioux, Scott, Story, Washington, Webster, Winnebago, Woodbury, Worth, and Wright counties.

Conocephalus brevipennis (Scudder)

- 1862 Xiphidium brevipennis Scudder, Canadian Nat. and Geol. 7:285.
 1891 Xiphidium brevipenne Redtenbacher, Verh. Zool. - Bot. Gesells. Wien, p. 520.
 1891 Xiphidium ensiferum Redtenbacher, Verh. Zool. - Bot. Gesells. Wien p. 523.
 1892 Xiphidium brevipennis Osborn, Proc. Iowa Acad. Sci. 1(2):119.
 1897 Xiphidium brevipenne Ball, Proc. Iowa Acad. Sci. 4:238.
 1898 Xiphidium ensiferum Saussure and Pictet, Biol. Centr. Am. Orthop. 1:400.
 1906 Anisoptera ensiferum Kirby, Synon. Catal. Orthop. 2:281.
 1912 Conocephalus ensifer Karny, Gen. Insectorum, Fasc. 135:9.

Color pale reddish-brown through green with vertex, occiput and pronotum bearing dorsally a posteriorly-widening, pale-bordered brown stripe; tegmina rarely greenish; sides of abdomen usually marked on upper half with a broad, indistinct stripe; fastigium not noticeably ascending, its side feebly diverging; tegmina longer than wings, covering two-thirds or all of abdomen; hind femur rarely armed beneath; prosternum with a pair of long slender spines. Length of body, 11-14 mm.

The known range of C. brevipennis extends across southern Canada as far west as Ontario and in the United States east from Minnesota, Nebraska, and Texas, and south to Florida. Another inhabitant of moist meadows and stream-side fields, this species was reported by Wheeler (151) as laying its eggs in a gall formed on a willow by a cecidomyid fly.

The small series of specimens studied bracketed the dates of August 11 and October 30. Literature records of Iowa occurrence were also given by Karny (77), Hendrickson (71), and Knutson and Jaques (86).

Buchanan, Clayton, Dickinson, Muscatine, Story, Washington, and Winnebago counties.

Conocephalus nemoralis (Scudder)

- 1875 Xiphidium nemorale Scudder, Proc. Boston Soc. Nat. Hist. 17:462.
 1897 Xiphidium nemorale Ball, Proc. Iowa Acad. Sci. 4:238.

Color dark greenish- to reddish-brown, vertex and pronotal disk usually with a broad, pale-margined, median brown stripe; all femora dotted with reddish-brown; fastigium but slightly ascending, strongly widened apically; tegmina (in our specimens) reaching nearly or quite to apex of abdomen; hind femur unarmed beneath; prosternum with a pair of long, slender spines. Length of body, 13-15 mm.

This species ranges from New York west to Minnesota, Nebraska, and Kansas and south to North Carolina and Tennessee. Specimens are usually collected from low undergrowth in woods.

With the original description Scudder (loc. cit.) listed "14 males, 24 females, 'taken only in groves' by Mr. J.A. Allen, Sept. 1-3, in Dallas County, Iowa." These type data were subsequently listed by Rehn and Hebard (120) who also designated one of these specimens as the type.

Other listings were given by Blatchley (8), Hendrickson (71), and Knutson and Jaques (86). The season of adult occurrence, as indicated by specimen data, is from early August until the frosts of October.

Boone, Cedar, Dallas, Henry, Iowa, Johnson, Muscatine, Ringgold, Sioux, Van Buren, Washington, and Woodbury counties.

Conocephalus strictus (Scudder)

1875 Xiphidium strictus Scudder, Proc. Boston Soc. Nat. Hist. 17:460.

General color green with usual broad, dark, pale-margined, median stripe on dorsum of head and pronotum, this sometimes extending onto abdomen in female and one-half in male; hind femur unarmed below; prosternum with two long, slender spines. Length of body, males, 14-15; females, 17-18 mm. (Fig. 17).

This species ranges from New York west to South Dakota and Nebraska and south and southwest to North Carolina, Oklahoma, Texas, and Arizona. Its preferred habitat is in dry upland fields, pastures, and prairies.

This common species has been reported for the state by Rehn and Hebard (120), Hendrickson (70, 71), and Knutson and Jaques (81). Adults have been collected between July 23 and September 25. Of the more than 150 specimens examined, all but one male had abbreviated flight organs.

Adair, Audubon, Benton, Black Hawk, Boone, Buena Vista, Cass, Clarke, Clayton, Des Moines, Dickinson, Fremont, Hamilton, Henry, Humboldt, Iowa, Jackson, Johnson, Linn, Lyon, Mills, Muscatine, Page, Palo Alto, Pocahontas, Polk, Plymouth, Sioux, Story, Van Buren, Warren, Washington, Winnebago, and Woodbury counties.

Conocephalus nigropleurum (Bruner)

1891 Xiphidium nigropleurum Bruner, Canadian Ent. 23:58.

1892 Xiphidium nigropleurum Osborn, Proc. Iowa Acad. Sci. 1(2):118.

1897 Xiphidium nigropleurum Ball, Proc. Iowa Acad. Sci. 4:238.

Color usually bright green with middorsal dark stripe strongly marked only on head, hind femora frequently bright yellow basally; green color sometimes replaced by yellow brown; fastigium slightly ascending, its sides feebly divergent; tegmina extending three-fourths or all the way to tip of abdomen; hind femur usually armed below on outer margin with one to five spines; prosternum with a pair of long slender spines. Length of body, 14-17 mm.

The range of this more northern species is rather limited in the United States; it occurs from New York west to Wisconsin and Nebraska and south to southern Indiana and eastern Kansas. Both open and woodland situations offer it haven.

Although not common in Iowa it has been reported for the state by Rehn and Hebard (120), Hendrickson (71), and Knutson and Jaques (86). Studied specimens had been collected between July 25 and September 16.

Clay, Crawford, Dickinson, Hancock, Johnson, and Story counties.

Conocephalus attenuatus (Scudder)

1869 Xiphidium attenuatum Scudder, Trans. Am. Ent. Soc. 2:305.

1892 Xiphidium lanceolatum Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Xiphidium attenuatum Ball, Proc. Iowa Acad. Sci. 4:238.

1900 Xiphidium lanceolatum Scudder, Proc. Dav. Acad. Nat. Sci. 8:74.

Color dull brownish-yellow, rarely tinged with green; upper surface of head and pronotum with a broad brown stripe; all femora speckled with reddish-brown; fastigium with sides subparallel; tegmina usually reaching to apical fourth or tip of abdomen, uncommonly fully developed; hind femur usually armed beneath on outer margin with one to five spines; prosternum with a pair of long slender spines, Length of body, 12-16 mm.

C. attenuatus ranges from New York and Pennsylvania westward to eastern Nebraska and Kansas. It occurs most frequently in lush grassy growth in the vicinity of marshes, swamps, and open water.

Additional literature references to local occurrence are given by Hendrickson (71) who found it at "Spartina consocias," and Knutson and Jaques (86). Of the thirty-two specimens seen, four (all collected in 1897) had fully developed wings. The entire series had been collected between August 12 and September 16.

Dickinson, Iowa, Johnson, and Story counties.

Conocephalus saltans (Scudder)

1872 Xiphidium saltans Scudder, Final Rept. U.S. Geol. Surv. Neb. p. 249.

1891 Xiphidium modestum Bruner, Canadian Ent. 23:57.

General color dull reddish-yellow or greenish-brown with prominent, broad, pale-margined dark stripe on dorsum of head and pronotum, and sometimes on upper surface of abdomen; femora all variously spotted with reddish-brown; fastigium strongly ascending, distinctly widening apically; tegmina usually abbreviated and covering less than basal third of abdomen; hind femora unarmed on lower margins; prosternum unarmed. Length of body, 11-15.5 mm.

The known range extends from Massachusetts north and west to Ontario, Montana, Colorado, and south and southwest to Georgia, Texas, and New Mexico. This insect is to be found in dry, sandy areas of short grasses.

Rehn and Hebard (120), Hendrickson (71), and Knutson and Jaques (86) all listed it for the state. Hendrickson (71) made the following comment on this species in his prairie studies; "common at all Andropogon associations." July 25 and October 18 mark extremes of dates found on adult specimens in local collections.

Dallas, Dickinson, Fremont, Hamilton, Hancock, Humboldt, Jefferson, Johnson, Kossuth, Lyon, Muscatine, Osceola, Plymouth, Story, and Winnebago counties.

Subfamily DECTICINAE¹ Brunner

1878 DECTICIDAE Brunner, Verh. Zool. - Bot. Gesells. 38:256. Wien.

¹Roberts (128) has presented evidence that this subfamily should receive the name Tettigoniinae; but Gurney (ms.) has furnished information that application has been made to the International Commission on Zoological Nomenclature to take action so that the present, still widely-used name may be retained. In view of possible favorable action the better known name is used here.

Face broad, almost perpendicular; eyes small, subglobose, separated by at least three times the diameter of one of them; vertex narrower than interocular width; strongly declivent between antennae; pronotum with front margin truncate, hind one convex, lateral lobes usually longer than deep; prosternum usually with two long slender spines; front coxae spined; hind tibiae with four apical spines beneath; tarsi more or less depressed, segments I and II sulcate laterally; cerci of male variable; ovipositor stout, nearly straight.

The sombre browns and grays which color these insects correspond closely to the dead leaves and other debris on the floor of the upland woods in which they dwell. These insects are active only during the hours of darkness and so have eluded close study, their habits being relatively unknown. In feeding they appear to be omnivorous, eating living or dead plant or animal matter.

Three of the twenty-three Nearctic genera treated by Caudell (15) belong to Iowa's fauna. Gurney (38) has more recently treated part of these.

Key to the Genera of DECTICINAE in Iowa

1. Prosternum armed with a pair of spines 2
Prosternum not spined; pronotal disk smooth, without lateral
carinae on anterior half Anabrus p. 297
2. Pronotum with lateral carinae distinct Atlanticus p. 295
Pronotum with lateral carinae absent, or at most vaguely
suggested Pediodes p. 296

Genus Atlanticus Scudder

1894 Atlanticus Scudder, Canadian Ent. 26:179.

Head not prominent; pronotum extended posteriorly over base of abdomen, lateral carinae present; lateral lobes broader than deep; tegmina in part or wholly concealed under posterior pronotal process; prosternum usually with a pair of slender spines; front femur unarmed or with 1-5 spines on outer lower margin; hind femur unarmed beneath or with several spines on inner margin; male cerci subcylindrical, armed submedially on inner side with a tooth; ovipositor straight or only slightly curved.

Genotype: Decticus pachymerus Burmeister.

Two of the nine species of this genus as revised by Rehn and Hebard (121a) occur in Iowa.

Key to the Species of Atlanticus in Iowa

1. Hind femora less than twice as long as pronotum; male with exposed part of tegmina more than half as long as pronotum; female with lateral apices of subgenital plate evenly rounded or transversely truncated A. testaceus p. 296
- Hind femora at least twice as long as pronotum; male with exposed part of tegmina about one-third as long as pronotum; female with lateral apices of subgenital plate distinctly angled apically A. davisii p. 296

Atlanticus testaceus (Scudder)

1901 Engoniaspis testaceus Scudder, Proc. Dav. Acad. Nat. Sci. 8:96.

Male: grayish or fuscous, sides of pronotum and tegmina blackish; lateral lobes with curved yellow line along hind margin; femora with numerous tiny pale dots. Female: grayish- or reddish-brown with a black dash above yellow line on side of pronotum. Head large, inserted into pronotum almost to eyes; pronotal disk large, width about two-thirds of length; lateral carinae distinct, coarctate, closest together at apical fifth; hind margin rounded or truncate; tegmina of male equal to pronotal width; ovipositor as long as hind femora, tapering at apex only on top side. Length of body, 18-25 mm.

The known range is chiefly in the northeastern part of the country from Vermont, Massachusetts, and Ontario west to Iowa and Kentucky and south into South Carolina. The "home" of this insect appears to be in dry, upland woods.

A single specimen in the Iowa Insect Survey Collection labelled "Mt. Pleasant, Iowa, Sept. 21, 1934, Crane" and determined by Hebard probably was the basis for the state listing by Knutson and Jaques (86). In the R. L. King collection were four males collected by King in Henry County on July 18, 1937.

Atlanticus davis Rehn and Hebard

1916 Atlanticus davis Rehn and Hebard, Trans. Am. Ent. Soc. 42:58.

Male: usually dark blackish-brown, flecked with gray; hind femora paler on apical third. Female: reddish- or yellowish-brown, marked with brown or black as follows: flecks on face, entire hind lobe of pronotum, dorsum of abdomen and ovipositor; pronotum about two-thirds as wide as long, lateral carinae coarctate, not sharp, closest together at apical third; lateral lobes of pronotum longer than deep; ovipositor slightly longer than hind femora. Length of body, 16.8-26.5 mm.

This insect ranges from New York west to Iowa and south to Virginia. It occurs on thinly wooded, rocky slopes.

The only Iowa record available was given by Rehn and Hebard (121a) as follows: "Keokuk, Iowa, VII, 19, 1913, (M.P. Somes; near rocks in timber at foot of bluff), 1 female (Somes Cln.)." This information was repeated, at least in part, by Hebard (57, 59).

Genus Pediodes Rehn and Hebard

1916 Pediodes Rehn and Hebard, Trans. Am. Ent. Soc. 42:45.

Vertex about one-third as broad as interocular area; pronotum moderately produced posteriorly, rounded above; prosternum with a pair of distinct spines; tegmina of males projecting beyond hind margin of pronotum for distance of not more than one-third length of pronotum and overlapping along sutural margins, tegmina of female nearly or quite wholly covered by pronotum; front tibiae spined on one or both upper margins; hind femora more than twice as long as pronotum and strongly swollen basally; hind tibiae with four apical spines below; supra-anal plate small, rectangular; male cerci with a large tooth on inner margin; ovipositor longer than pronotum and generally upcurved.

Genotype: Stipator grandis Rehn

Only one species occurs as far north and east as Iowa.

Pediodes nigromarginata (Caudell)

1902 Orchesticus nigromarginata Caudell, Trans. Am. Ent. Soc. 28:89.

1930 Pediodes "sp." Hendrickson, Iowa State Coll. Jour. Sci. 4:63.

Color gray through various shades of brown with a variably developed blackish lateral infuscation from sides of fastigium backward over eyes, upper part of lateral lobes of pronotum and abdomen; lateral lobes of pronotum longer than deep, hind margin strongly oblique, sinuate; lateral pronotal carinae obsolete to absent, sometimes indicated by pale stripes; hind femora more than five times as long as basal width. Length of body, 19-28 mm. (Fig. 16).

This species is known to occur in the area from South Dakota and Iowa south through Nebraska, Kansas, and Oklahoma into Texas. It is uncommon and occurs in small bushy plants growing under plains conditions.

The few local specimens available for study consisted of two specimens (without hind legs) in the Iowa State College collection, one male and one female, labelled "Woodbury Co., Ia., VII-16, 1938, L.A. Spain;" and a specimen in the R.L. King collection from "Plymouth Co., Ia., August 28, 1935, R.L. King." Hendrickson's (71) report of "Pediodes sp. At Andropogon scoparius-Bouteloua curtipendula association, 15 mi. north of Sioux City, July 26, 1928, one specimen" probably belongs here. In this state it undoubtedly will be found to be restricted to the far western part.

Genus Anabrus Haldeman

1852 Anabrus Haldeman, Stansbury Explor. and Surv. Great Salt Lake, p. 371.

Head inserted into prothorax; eyes rounded, small, about one-third as high as subocular space; vertex decurved, about one-third as wide as interocular area; pronotum much produced posteriorly, median carina very faint, lateral carinae confined to metazona, transverse sulci inconspicuous, but V-shaped depression usually evident on disk; tegmina and wings of male but slightly projecting beyond hind margin of pronotum and overlapping, of female usually greatly reduced and wholly covered by pronotum; hind femora (in our species) less than twice as long as pronotum, spined below on both margins; subgenital plate in both sexes with broad apical notch; cerci of male flattened and forming two incurved teeth internally; ovipositor varying in length from slightly shorter to slightly longer than hind femora, usually slightly and uniformly upcurved.

Genotype: Anabrus simplex Haldeman.

A single species of this western genus is known to occur as far east as westernmost Iowa.

Anabrus simplex Haldeman

1852 Anabrus simplex Haldeman, Stansbury Explor. and Surv. Great Salt Lake, p. 372.

Color light yellow through green to black, either uniformly so or evenly mottled, or with abdomen or posterior part of male pronotum frequently

blackened; posterior margin of pronotum rounded or truncated; anterior tibiae with 3-5 spines on outer upper margin, with 0-3 spines on upper inner margin; male cerci with internal teeth nearly parallel, interspace broadly U-shaped. Length of body, 24-42 mm.

The known general range of this species is outlined by the following political units; Saskatchewan in the north; Minnesota, Iowa, and Kansas to the east; Washington, Oregon, and California to the west; and New Mexico to the south. This large clumsy insect occurs only under the more arid conditions that are typical of the Great Plains. Gurney (38) has discussed this and some related forms.

Definite occurrence of the "Mormon cricket" within the state was established by H. E. Jaques when he collected two males in Pottawattamie County on July 15, 1938. No other local specimens were available for study.

Family GRYLLACRIDIDAE¹ Stal

1874 GRYLLACRIDAE Stal, *Recensio Orthop.* 2:105.

Tegmina and wings absent or present and showing variable development, tegmina without stridulatory field or tympanum; tarsi nearly always four-segmented; cerci elongate, usually flexible, with numerous long, erect hairs; ovipositor compressed.

Of the nine subfamilies now accredited to this family only one is known to occur in Iowa. Since the habits of the various subfamilies differ to a considerable degree generalizations concerning family habits are difficult to form. Consequently, these will be omitted here in favor of giving more specific details under the subfamily heading of the single subfamily known to occur in Iowa.

Subfamily RHAPHIDOPHORINAE Brunner

1888 RHAPHIDOPHORAE Brunner, *Verh. Zool.-Bot. Ges. Wien.* 38:256.

Fastigium strongly compressed between subcontiguous antennal bases, sometimes distinctly sulcate; antennae filiform, very long; pronotum transversely convex, without lateral carinae, of same general form as meso- and metanota; tegmina and wings absent; femora swollen, at least basally, sometimes toothed beneath; hind tibiae strongly serrate above on both margins, usually with several long movable spines interspersed, apex with three pairs of spines; tarsi without or with but one pulvillus; male cerci long, slender, unarmed; ovipositor tapering from stout base to usually blunt apex.

The wingless "cave-" and "camel-cricket" are generally very secretive in habits and hide in crevices or under objects in caves, basements, quarries, hollow trees, and other moist, secluded places. At night they wander about seeking food and mates, for unlike some of the other families of jumping Orthoptera they have neither sound-producing nor sound-detecting organs. Under natural conditions their food appears to be derived from plant and animal sources, both living and dead. Sometimes, in greenhouses some species attack seedlings or succulent parts of growing plants; and when abundant in basements they become a nuisance to

¹Correct spelling of name, vide Hubbell (74).

householders. At least some of the species of this subfamily are known to lay their eggs in soil or rotten wood, while the burrowing species usually place them in their tunnels.

Caudell (19) and Hubbell (74) gave keys to the genera of this subfamily. The latter author recognized sixteen genera from North America, of which three, one an established adventive, occur in Iowa.

Key to the Genera of RHAPHIDOPHORINAE in Iowa

1. Fastigium with a pair of close-set, acute, conical lobes which are at least twice as long as basal width (Fig. 109); spines on upper side of hind tibiae arranged in groups in which spines become longer distally Tachycines p. 299
- Fastigium without such paired, conical lobes 2
2. Front tibiae with a spine on upper inner margin just beyond middle Udeopsylla p. 310
- Front tibiae without a spine on inner upper edge. Ceuthophilus p. 300

Genus Tachycines Adelung

1902 Tachycines Adelung, Ann. Mus. Zool. Acad, Imp. Sci. St. Petersburg, 7:56.

Head oblong, short, as wide as front of pronotum; pronotum longer than meso- or metanota, but not deeper; front femora with a long, movable spine on outer apex; front and middle tibiae each with one or two movable spines beneath; hind femur with five or six short, stout spines on lower margin; hind tarsus with first segment prolonged above base of second as a spine; male cerci long, slender, cylindrical, tapering to a point; ovipositor about one-and-a-half times as long as pronotum, gently upcurved on apical half, inner valves finely crenate beneath.

Genotype: Tachycines asynamorus Adelung.

The single species attributed to the genus has been introduced into Iowa on several occasions.

Tachycines asynamorus Adelung

1902 Tachycines asynamorus Adelung, Ann. Mus. Zool. Acad. Imp. Sci. St. Petersburg, 7:59.

Brownish-yellow, body and femora mottled with dark brown; surface with fine, appressed yellowish pubescence; front femora nearly twice as long as pronotum; hind leg with tibia longer than femur; ovipositor almost half as long as hind femur. Length of body, 14-16 mm.

Although the "greenhouse stone cricket" was originally described from material collected in a greenhouse in the city which is now Leningrad, Russia, it appears to be a native of China. From that country it has been carried into many parts of the world. In the United States this species has become established in greenhouses and has been reported from at least ten states. Rehn (110) wrote, "In all probability Tachycines asynamorus will become very generally established in suitable situations over much of the United States. . . ." Until 1925, when Hebard pointed out the error, this species had appeared in American literature as Diestrammena marmorata Hahn and D. japonica Blatchley.

Several specimens in the Iowa State College collection had been taken in campus greenhouses, while some in the R. L. King cabinet were labeled "in cellar." Specimens studied bore data that showed nymphs during May and adults during May, July, and November, and that the species was present in the state as early as 1933. Knutson and Jaques (86) listed it for the state.

Clinton, Henry, and Story counties.

Genus Ceuthophilus Scudder

1862 Ceuthophilus Scudder, Boston Jour. Nat. Hist. 7:433.

Body thick, dorsum usually strongly arched; head oval, oblique, mouthparts usually directed backwards between front legs; eyes narrowed below, placed above and close to bases of antennae; last segment of palpi distinctly longer than third and deeply sulcate beneath for at least three-fourths of its length; front and middle femora slender, former less than twice as long as pronotum, both spined ventrally; hind femora swollen, turned inwards at base, grooved beneath, ventral margin weakly to strongly serrate or spined; hind tibiae usually longer than hind femora and with several pairs of long movable spines among the short dorsal teeth; hind tarsi with basal segment not prolonged as spine above base of second, latter distinctly longer than deep; male subgenital plate broad, usually emarginate or deeply cleft medially; ovipositor nearly straight, inner valves with 3-7 teeth below on apical fourth.

Genotype: Rhaphidophora maculatus Harris.

This genus, at the time of its last monographic revision by Hubbell (74), contained eighty-nine species and races. The general distribution of fourteen species indicated that they should occur in Iowa. Definite state records have been available for twelve of these. The literature previous to Hubbell's study was quite confused and contained many synonyms and misidentifications; this was true of records for Iowa as well as other states, but fortunately Hubbell corrected nearly all of these.

Key to the Species of Ceuthophilus¹ in Iowa

1. Large spines of hind tibiae blackened at base; dorsum with broad, nearly solid piceous to black stripe either side of wide, pale, median line. C. latens p. 303
- Large spines of hind tibiae not blackened basally 2
2. Males (abdomen not terminated by compressed, sword-like ovipositor 3
- Females (abdomen terminated by compressed, sword-like ovipositor) 15
3. Eighth abdominal tergite, viewed laterally, not differing noticeably in shape from seventh; ninth tergite usually distinctly surpassing eighth. 4

¹The Phalangopsis lapidicola listed by Bessey (6) and Osborn (98) was stated by Hubbell (74) possibly to represent C. latens, C. elegans, or "some other species." Ceuthophilus lapidicola Scudder occurs much farther east and so does not belong to the local fauna.

- Eighth abdominal tergite with hind margin decidedly thickened or markedly recurved, usually concealing ninth tergite from above. 12
4. Hind tibiae conspicuously sinuate in basal third (Fig. 115) . . . C. masculatus p.304
 Hind tibiae straight in basal third . . . 5
5. Lower front margin of hind femora with twenty or more spines. 8
 Lower front margin of hind tibiae with fifteen or less spines or teeth . . . 6
6. Upper surface, including pronotum, with abundant prostrate, minute yellow hairs; ninth tergite surpassing eighth and elevated posteriorly . . . C. pallidus p. 305
 Upper surface of pronotum without minute yellow hairs; ninth tergite not surpassing eighth and/or strongly deflexed . . . 7
7. Upper outer angle of middle coxae distinctly produced as an acute or rounded lobe (Fig. 112) . . . C. divergens p. 307
 Upper outer angle of middle coxae rectangular, not produced. . . C. uhleri p. 306
8. Hind margin of ninth tergite strikingly recurved (Fig. 21), appearing broadly emarginate when viewed from above. C. seclusus p. 304
 Hind margin of ninth tergite not markedly recurved . . . 9
9. Hind margin of ninth tergite with large, hinged, flat lobe or flaps dorso-laterally, these appearing as a pair of large flat claspers (Fig. 113). . . C. kansensis p. 305
 Hind margin of ninth tergite truncated medially, without hinged flaps laterally . . . 10
10. Apex of subgenital plate with a finger-like lobe either side of median deep, V-shaped notch (Fig. 118); thorax above not transversely banded but with scattered, yellowed spots. . . C. brevipes p. 302
 Apex of subgenital plate with a bluntly triangular lobe either side of median notch (Fig. 114); hind margins of thoracic segments with broad, dark brown margins, meso- and metanota not sprinkled with paler spots . . . C. williamsoni p. 303
11. Hind margin of eighth tergite prolonged as a large flat plate longer than tergites six and seven united, apex broadly truncated (Fig. 117) . . . C. nodulosus p. 309
 Hind margin of eighth tergite not prolonged as flat plate, at most only slightly longer than tergite seven . . . 12
12. Eighth tergite produced either side of median emargination as deflexed lateral lobes . . . C. silvestris p. 308
 Eighth tergite neither emarginate nor with deflexed lobes laterally. 13
13. First segment of hind tarsus with a row of short bristle-like setae on basal two-thirds or more of ventral margin; hind tibiae with but one subapical spine below . . . 14
 First segment of hind tarsus without setae except a few at base, hind tibiae usually with two subapical spines below. . C. alpinus p. 309
14. Pseudosternite¹ dorsally with a short, apically emarginate, transverse plate directed posteriorly (Fig. 108). . C. fusiformis p. 307

¹A sclerotized, internal plate of male genitalia; best seen by relaxing and depressing the subgenital plate and slipping back the membrane which closes it dorsally.

- Pseudosternite dorsally with a conspicuous compressed process directed posteriorly (Fig. 107). . . . C. elegans p. 308
15. Apical margin of subgenital plate emarginate either side of median angulation or tooth (Figs. 110, 111) 16
 Apical margin of subgenital plate simple, neither toothed nor emarginate 17
16. Apical emarginations of subgenital plate deep, median tooth slightly more prominent than lateral lobes (Fig. 110) C. . C. seclusus p. 304
 Apical emarginations of subgenital plate shallow and broad, lateral lobes small and appearing adrounded angulations on sides of broadly triangular median one (Fig. 111). . . C. kansensis p. 305
17. Dorsum of thorax with abundant, minute, prostrate yellow hairs C. pallidus p. 305
 Dorsum of thorax without abundant prostrate hairs 18
18. Dorsum of thorax dull or weakly sericeous . . . C. uhleri p. 306
 Dorsum of thorax polished 19
19. Ovipositor at least 7 mm. long 20
 Ovipositor less than 7 mm. long 21
20. Lower front margin of hind femora with twenty or more denticulations C. williamsoni p. 303
 Lower front margin of hind femora with fifteen or less denticulations C. maculatus p. 304
21. First segment of hind tarsi with a row of bristle-like setae on basal two-thirds or more of ventral margin 22
 First segment of hind tarsi without setae below except for a few at base 24
22. Dorsal pattern, including upper and outer face of hind femora, dark with pale maculations, some of which may unite to form median pale line on thorax 23
 Dorsal pattern clay to buff with fuscous bands across hind margins of segments; hind femora appearing pale, inconspicuously maculate (not separable in females with any certainty).
C. elegans p. 308, C. fusiformis p. 307, and C. silvestris p. 308
23. Fastigium produced as a deflexed, acute cone which is distinctly more prominent than the raised inner margin of antennal sockets C. divergens p. 307
 Fastigium low, rounded, not more prominent than raised inner margins of antennal sockets C. brevipes p. 302
24. Lower front margin of hind femora with 12-22 denticulations; ovipositor at least one-fourth longer than pronotum.
 C. alpinus p. 309
 Lower front margin of hind femora with 5-8 denticulations; ovipositor not longer than pronotum C. nodulosus p. 309

Ceuthophilus brevipes Scudder

1862 Ceuthophilus brevipes Scudder, Boston Jour. Nat. Hist. 7:434.

Color above dark brown to piceous, much spotted with yellow, median pale line usually much interrupted; hind femora definitely patterned; hind tibiae embrowned above, spots at bases of movable spines and the large spines themselves pale; fastigium low, rounded, about as prominent as raised inner margins of antennal sockets; dorsum shining, becoming duller

toward apex of abdomen; hind femora 2.5–3.5 times as long as pronotum; dorsal spines of hind tibiae unicarinate or with a second weaker one laterally; male with eighth tergite weakly produced medially, ninth tergite emarginate medially, subgenital plate with percurrent median sulcus and hind margin produced as finger-like lobes either side of very narrow V-shaped median notch; ovipositor 1.5–2 times as long as pronotum, with five or six teeth below near apex. Length of body, 13–15 mm.

This insect is known to range in southern Canada and northern United States from the Atlantic coast west to Ontario, Wisconsin, and Iowa and south to Virginia, Ohio, and Kentucky. It is usually to be found in wooded sections, especially those which are cool and moist.

This species is included on the basis of one male and one female collected by R. L. King in Clayton and Delaware counties respectively on August 8, 1937. These records mark a westward extension of range for the species.

Ceuthophilus williamsoni Hubbell

1934 Ceuthophilus williamsoni Hubbell, Bull. Ill. St. Nat. Hist. Surv., 20:230.

Color dark brown with head, large oval patch either side of middle of pronotum, basal half of meso- and metanotum and elongate spots on abdominal tergites yellowed; hind femora with rows of oblique yellow spots; fastigium low, rounded, less prominent than raised inner margins of antennal sockets; dorsum weakly shining, less so on abdomen which is distinctly hairy; hind femora approximately 3–3.5 times as long as pronotum; male subgenital plate divided medially by percurrent sulcus; ovipositor 1.75–2.25 times as long as pronotum. Length of body, 16–18 mm.

This species is known from Illinois, Iowa, and Missouri. In habits this is a rock-loving species that frequently enters caves, wells, and similar shelters.

Among the paratypic material listed by Hubbell (73) were Iowa specimens from Clayton and Lyon counties with nymphs and adults being reported to be present in the former county during July and August. At the time of writing, the Clayton specimens were in the Iowa Insect Survey collection and the Lyon County specimen is in the collection of Iowa State College. One other specimen was studied; it was a male from Polk County dated for April 25. Later reports for the state have been given by Knutson and Jaques (86), Hubbell (74), and Karny (78).

Ceuthophilus latens Scudder

1862 Ceuthophilus latens Scudder, Boston Jour. Nat. Hist. 7:437.

Thorax above with very broad yellow to light brown median stripe bordered on either side by a broad, more or less complete black stripe which may contain a few light flecks; abdomen usually black with abundant elongate pale spots; lower halves of lateral lobes of thoracic segments and underside of body pale yellow; dorsum glabrous, polish slightly dulled by minute transverse wrinkles, more numerous and distinct on abdomen; fastigium broad, slightly convex to flat, in profile obtusely angled and slightly more prominent than inner margins of antennal fossae; hind femora about 2.5–3 times as long as pronotum; dorsal spurs of hind tibiae

unicarinate above; male with ninth tergite slightly projecting and weakly sclerotized, subgenital plate sulcate throughout median length and very broadly V-shaped posteriorly; female with hind margin of subgenital plate entire, ovipositor about 1.5–2 times as long as pronotum. Length of body, 12–21 mm.

The general range of this species is located in the northern United States from Massachusetts west to Minnesota, south to Virginia along the coastal states and south to Tennessee in the Mississippi Valley. C. latens is an inhabitant of forested areas, apparently regardless of soil type involved.

At hand during this study were adult records for the period from June 4 to September and late instar nymphs for June and early July. Iowa listings were given by Hubbell (73, 74) and Knutson and Jaques (86).

Bremer, Clayton, Johnson, and Linn counties.

Ceuthophilus maculatus (Harris)

1841 Rhaphidophora maculata Harris, Rept. Ins. Mass. p. 126.

1897 Ceuthophilus blatchleyi Ball, Proc. Iowa Acad. Sci. 4:237.

1900 Ceuthophilus blatchleyi Scudder, Proc. Dav. Acad. Nat. Sci. 8:81.

Color above dark brown with a more or less interrupted median pale line and numerous scattered yellow flecks and blotches; hind femora distinctly patterned with brown and yellow; fastigium blunt, slightly overhanging, upper surface sometimes faintly grooved; upper surface glabrous, polished; abdomen with transverse wrinkles more numerous than those on thorax; pronotum with series of broad, shallow impressions either side of midline; hind femora of male with 6–18 prominent stout spines on apical two-thirds of lower front margin, these represented by minute denticulations in female; male subgenital plate sulcate medially for full length, outer hind angles prominent, hind margin medially with a pair of low, rounded projections; ovipositor 1.5–2 times as long as pronotum. Length of body, 10–19 mm.

The general range occurs across southern Canada and the United States as far west as Manitoba, the Dakotas, and Nebraska south to Maryland and Ohio in the east and to Arkansas in the Mississippi Valley. It inhabits the drier forested conditions found in this territory.

The season for adults of this species was indicated by available records to extend from June 13 to August 23; several nymphs had been collected in June and August. Under the currently used name it was reported for the state by Osborn (98), Scudder (134), Hebard (51, 54), Knutson and Jaques (86), and Hubbell (74).

Boone, Bremer, Cedar, Cerro Gordo, Clayton, Dickinson, Fayette, Grundy, Johnson, Story, and Winnebago counties.

Ceuthophilus seclusus Scudder

1894 Ceuthophilus seclusus Scudder, Proc. Am. Acad. Arts Sci. 30:45.

1925 Ceuthophilus maculatus Hebard, Proc. Acad. Nat. Sci. Phila. 77:140.

Dark fuscous, variously mottled with dull yellow blotches, median stripe often present on pronotum; dorsum weakly polished, minutely reticulate, with scattered long setae on hind part of pronotal disk and posterior

margins of abdominal tergites; fastigium prominent, strongly declivent, often faintly sulcate; pronotal disk in all females and some males normal, convex with median pairs of slight impressions behind front margin and another larger one either side of middle at mid-length of pronotum; second type of pronotal surface appears in some males, surface appears greatly deformed by deepening of usual discal impressions and the presence of a two-lobed protuberance arising from the middle of the discal impression, all intermediates between this and the normal type are known; abdomen convex, at most weakly tectate; hind femora 2.8-3.4 times as long as pronotum; male subgenital plate sulcate medially for full length, hind margin broadly triangular either side of middle; ovipositor 1.5-2 times as long as pronotum. Length of body, 13-19 mm. (Fig. 21).

C. seclusus ranges from Indiana west to Iowa, Nebraska, and Kansas and south to Arkansas and Oklahoma. It apparently inhabits forests on dry stony soils and only occasionally enters caves.

It was described originally by Scudder (134) in part from Crawford and Dallas counties; the lectotype and lectallotype were chosen from the type series and bear the data "Dallas Co., Iowa, Aug. 6, (J.A. Allen)." Subsequently it was reported for the local fauna by Ball (2), Scudder (143), Kirby (83), Rehn and Hebard (115), Blatchley (8), Karny (78), Hebard (63), Hubbell (72, 74), and Knutson and Jaques (86). Seasonal data on adults encompassed the period from June 29 to September 22, and on nymphs from May 8 to July 13.

Boone, Crawford, Dallas, Henry, Keokuk, Madison, Monroe, Muscatine, Sioux, Story, Webster, and Woodbury counties.

Ceuthophilus kansensis Hubbell

1936 Ceuthophilus kansensis Hubbell, Univ. Fla. Publ. Biol. Sci. Series, 2:231.

Color above dark brown to black with a more or less interrupted pale median stripe; fastigium low, rounded, faintly sulcate longitudinally, nearly as prominent as raised inner margin of antennal sockets; hind femora about three times as long as pronotum; male subgenital plate subquadrate in outline, median sulcus extending full length, posterior margin truncate with small median V-shaped notch; ovipositor slightly more than twice as long as pronotum. Length of body, 13-19 (?) mm.

This species was described and is known only from a few specimens from the northeastern part of Kansas. The nearness of this locality to Iowa indicates that it might be found in Iowa.

No specimens from Iowa or other localities were available for study. The enlarged flat clasper-like extensions of the ninth abdominal tergite should enable one to recognize the male immediately.

Ceuthophilus pallidus Thomas

1872 Ceuthophilus pallidus Thomas, Rept. U.S. Geol. Surv. Terr. Mont. and adj. Terr. p. 434.

1892 Ceuthophilus divergens Osborn, Proc. Iowa Acad. Sci. 4:119.

1894 Ceuthophilus bruneri Scudder, Proc. Am. Acad. Arts. Sci. 30:80.

1900 Ceuthophilus bruneri Scudder, Proc. Dav. Acad. Nat. Sci. 8:81.

Color above dark brown patterned with yellow to reddish-yellow; mid-dorsal pale stripe appearing as row of pale triangles because of its constriction or interruption on hind margin of each segment in intensively colored material, in pallid material dark color of abdominal segments reduced to pair of blotches on hind margin; hind femora usually showing rows of oblique, distinct pale marks; dorsum conspicuously setose in both sexes; fastigium low, rounded, blunt, about as prominent as raised inner margins of antennal fossae; hind femora 2.5–3 times as long as pronotum; male with four or five spines just beyond middle of lower front margin considerably enlarged; female with six to eight very small and widely separated denticles on lower front margin; subgenital plate sulcate throughout, hind margin faintly, broadly and angularly concave; ovipositor 1–2 times as long as pronotum. Length of body, 10–16 mm.

The general range of the species extends from Manitoba south by way of the Great Plains and western border of the prairie region into Texas and in the southern part of its range west and north to Arizona and Utah. This appears to be a species of great tolerance judging from reports of its having been found in field, forest, cave, and basement.

Hubbell (74) divided this species into several nontaxonomic "phases" on the basis of structural characters correlated with geography. All Iowa material examined during this study as well as local specimens reported by Hubbell in the above mentioned work definitely fell into the "Northern Great Plains phase" because upper apical angle of the middle coxae fell into the range of 60–70°, the average size was small and other characters of mathematical proportions. Adult dates were for the period from June 14 to August 27; nymphal records were all for July and represented later instars only. Hubbell (74) reported Iowa specimens in the National Museum which had been collected by Dayton Stoner from "nests of bank swallow and of burrowing sparrow." Other state listings were given in literature by Knutson and Jaques (86) and Karny (78).

Clay, Dickinson, Emmet, Fremont, Kossuth, Lyon, Polk, and Woodbury counties.

Ceuthophilus uhleri Scudder

1862 Ceuthophilus uhleri Scudder, Boston Jour. Nat. Hist. 7:435.

Color yellowish- to tannish-brown, pale pattern of median line and scattered blotches often very indistinct, normally contrasting but little with darker areas; hind femora showing usual rows of oblique pale markings; dorsum in both sexes smooth, dull or only very faintly shining; fastigium weakly to distinctly compressed, blunt apically, at least as prominent as raised inner margins of antennal sockets; pronotum lower front margin with some of spines as long as height of femora; male with ninth tergite nearly wholly concealed by eighth, subgenital plate with median sulcation for full length, hind margin produced into two broad, acute or blunt angles; ovipositor equal to or nearly twice as long as pronotum. Length of body, 13–16 mm.

This species ranges from New York west to Iowa and Kansas and southward in a large wedge west of the Appalachian Mountains and in the Mississippi Valley almost to the Gulf Coast in Mississippi, Alabama, and Florida. It frequents dry or moist woods on a variety of soils.

A small series of Iowa specimens from Webster County apparently

was the basis for all state records in literature. Hubbell (72, 74) reported them twice, the latter time with full data as follows: "Fort Dodge, Webster Co., July 19, 1910 M.P. Some 1 male, 3 females;" and Karny (78) undoubtedly followed Hubbell. No other local specimens have been available for study, but the species should occur over most of the southeastern quarter or more of the state.

Ceuthophilus divergens Scudder

1862 Ceuthophilus divergens Scudder, Boston Jour. Nat. Hist. 7:436.

1894 Ceuthophilus seclusus Scudder, Proc. Am. Acad. Arts Sci. 30:45.

1920 Ceuthophilus seclusus Blatchley, Orthop. N. Am. p. 629.

Color above dark brown with prominent but narrow median pale line which is often enroached upon by darker color of abdomen; dark color broken by pale spots and dashes on thorax and abdomen; hind femora distinctly patterned with brown and yellow; legs usually embrowned; dorsum shining; fastigium a prominent blunt cone, strongly deflexed; thorax smooth or with faint transverse wrinkles or both; abdomen usually more wrinkled and duller; hind femora of male spined for most of its length on lower front margin, spines at apical third usually stouter and longer, of female with minute spines or denticulations on apical half only; male subgenital plate with median sulcation for full length, apical margin produced, often as finger-like lobes, either side of median V-shaped notch; ovipositor at most but slightly longer than pronotum. Length of body, 8-15 mm.

The area from New York west to South Dakota and south to Louisiana and Mississippi comprises the range of this species. The insect apparently inhabits stream-side or other moist forests where it hides under rocks, logs, and other debris.

This species appears not too uncommon in local collections. Adults bore labels showing extremes of season to be June 14 and September 3. Additional local listings were given by Blatchley (7), Knutson and Jaques (86), Hubbell (74), and Karny (78).

Appanoose, Cedar, Clayton, Clinton, Dallas, Franklin, Henry, Iowa, Jackson, Johnson, Linn, Muscatine, O'Brien, Webster, and Woodbury counties.

Ceuthophilus fusiformis Scudder

1894 Ceuthophilus fusiformis Scudder, Proc. Am. Acad. Arts Sci. 30:28.

Coloration variable from wholly pale yellow to showing striking pattern of brownish-black on borders of tergites or with abdomen wholly darkened; pronotum usually with a pair of dusky stripes extending backwards from anterior marginal band; fastigium low, blunt, slightly more elevated than raised inner margins of antennal sockets; dorsum smooth, shining; hind femora 2-2.5 times as long as pronotum, lower front margin in male with numerous subequal denticulations on apical two-thirds or more, in female with fewer, wider-set denticulations; male subgenital plate produced as a broad, rounded, triangular lobe either side of median notch, median sulcus not reaching base of plate; ovipositor 1-1.5 times as long as pronotum. Length of body, 8-10 mm.

This is a form of the Great Plains; it ranges from Alberta south to Oklahoma and New Mexico and from Minnesota, Iowa, and Kansas west to

the eastern slopes of the Rocky Mountains. It is usually found under cover on the ground or in burrows of rodents under prairie conditions.

All Iowa records available were from the northwestern corner of the state where specimens had been collected during April, July, September, and October. Hubbell (74) and Karny (78) also listed it for the local fauna.

Dickinson, Emmet, Sioux, and Woodbury counties.

Ceuthophilus elegans Hubbell

1934 Ceuthophilus elegans Hubbell, Bull. Ill. St. Nat. Hist. Surv. 20:237.

1897 Ceuthophilus vinculatus Ball, Proc. Iowa Acad. Sci. 4:237.

1899 Ceuthophilus vinculatus Scudder, Canadian Ent. 31:119.

Color yellowish-brown, tergites black banded or wholly black, in latter case frequently with a transverse pale median spot, pronotum usually pale with front and hind margin and a median pair of dark stripes extending posteriorly from front fuscous to black; hind femora faintly to distinctly patterned; fastigium low, broad, at most slightly more prominent than raised inner margins of antennal sockets; dorsum polished; hind femora 2.25-3.5 times as long as pronotum, lower front margin with many small, subequal denticulations; male subgenital plate produced as a broad, rounded, triangular lobe either side of median notch, median sulcus not reaching base of plate, ovipositor 1-1.3 times as long as pronotum. Length of body, 7.5-11 mm.

This species was listed by Hubbell (74) from only four states, Illinois, Indiana, Iowa, and Wisconsin. It occurs in cultivated and uncultivated fields as well as in open woods.

Numerous specimens from the vicinity of Ames, Story County, were included among the paratypes of this species. The species appears to be fairly common in Iowa, but since the females cannot be separated reliably from that sex of C. fusiformis and C. silvestris they were not used in plotting the local distribution of any of the three species. All such data has been taken exclusively from males. Although Hubbell (74) states that adults and nymphs occur throughout the year, the many local specimens examined had been collected during March, April, and May in spring and September and October in autumn. Since the original description which included paratypes from Iowa the following authors have reported the species from the state: Knutson and Jaques (86), Hubbell (74), and Karny (78).

Appanoose, Des Moines, Henry, Jefferson, Johnson, Lucas, Montgomery, Polk, Story, Tama, and Wapello counties.

Ceuthophilus silvestris Bruner

1885 Ceuthophilus silvestris Bruner, Bull. Washburn Coll. 1:126.

Color either uniformly yellowish-brown or tergites showing broad, dark, marginal bands which sometimes completely suffuse abdomen; hind femora almost unicolorous; fastigium low, blunt, not higher than raised inner margins of antennal sockets; dorsum smooth, shining; hind femora 2.25-2.5 times as long as pronotum, lower front margin with numerous small, crowded, subequal denticulations; subgenital plate of male sulcate medially for part of its length, hind margin prolonged as broad, elongate but rounded lobes either side of narrow median cleft; ovipositor 1-1.5 times as long as pronotum. Length of body, 8-10 mm.

The recorded distribution of this species mentions but four states, Minnesota, Kansas, Missouri, and Arkansas. For a habitat this species frequents forested areas or denser brushgrowth on pastures and prairies.

The single Iowa specimen studied was a male in the collection of R. L. King. It had been taken in Henry County on March 9, 1936.

Ceuthophilus alpinus Scudder

1894 Ceuthophilus alpinus Scudder, Proc. Am. Acad. Arts Sci. 30:78.

Color above yellowish, front margin of pronotum, hind margin of all tergites and broad stripe either side of mid-disk of pronotum fuscous to blackish-brown; fastigium very low, bluntly rounded; dorsum of thorax shining; abdomen distinctly depressed basally; discal impressions of pronotum weak; hind femora 2-2.5 times as long as pronotum, lower front margin with 12-31 small, acute denticulations; hind tibiae convex above, upper lateral carinae obsolete; eighth tergite about as long as seventh, apically broadly truncate to slightly concave; male subgenital plate produced as a broad, rounded, triangular lobe either side of median notch, median sulcus not reaching base of plate; ovipositor 1.25-1.5 times as long as pronotum. Length of body, 8-10 mm.

C. alpinus is a northern species. It has been reported from British Columbia and Alberta south to Colorado and east through South Dakota and Nebraska to Iowa. It is probably a woods-dwelling, burrowing form.

The only local record seen during this study was the literature report of Hubbell (74): "Sioux City, Woodbury Co., C.N. Ainslie 1 male USNM." It will probably be found only in the western part of the state.

Ceuthophilus nodulosus Brunner

1888 Ceuthophilus nodulosus Brunner, Abh. Zool. - Bot. Gesells. Wien. 38:308.

Color above dark brown with median stripe on thorax and abdomen and numerous small, rounded blotches pale; hind femora with rows of oblique, pale bars; fastigium scarcely elevated, much less prominent than raised inner margins of antennal sockets; thoracic dorsum polished, rather coarsely and closely wrinkled near margins of segments, hind and side margins of meso- and metanota with sparse, coarse nodules (less distinct in female) which tend to form rows parallel with margins; hind femora about 2-2.5 times as long as pronotum, lower front margin with about seven denticulations and/or teeth; hind tibiae of male subequal in length to hind femora, strongly arcuate, with a strong triangular process on inner margin near base, of female straight, normally slightly shorter than hind femora; male subgenital plate entire with a median, apical, rounded projection which is constricted near base and slightly emarginate at apex; ovipositor not as long as pronotum. Length of body, 13-18 mm.

This species ranges from Texas and New Mexico north to Colorado and South Dakota and from the base of the Rocky Mountains to Kansas and Nebraska. Its occurrence in the eastern part of the last two states suggests that it will probably be found in the western part of Iowa. Adults, which occur in fall and winter in the more southern states, occur under cover and probably burrow into the soil in areas of sparse vegetation.

Genus Udeopsylla Scudder

1862 Udeopsylla Scudder, Boston Jour. Nat. Hist. 7:442.

Vertex deflexed, flattened and almost vertical; antennal segment III twice as long as II; eyes small, roundly triangular; meso- and metanota each about two-thirds as long as pronotum; all femora armed beneath, posterior pair with 8-20 small teeth on lower front margin and eight or more larger ones on hind margin; all tibiae spined beneath, anterior and median pair with a double row while the latter and hind pair also have two rows of spines set in sockets on upper side; hind tibiae have three or four small teeth between large spines of upper side; all tarsi four-segmented.

Genotype: Phalangopsis (Daihinia) robusta Haldeman.

A single variable species has been collected in Iowa.

Udeopsylla robusta (Haldeman)

1850 Phalangopsis (Daihinia) robusta Haldeman, Proc. Am. Assn. Adv. Sci. 2:346.

1892 Udeopsylla nigra Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1894 Udeopsylla nigra Blatchley, Proc. Ind. Acad. Sci. for 1892, p. 153.

1897 Udeopsylla nigra Ball, Proc. Iowa Acad. Sci. 4:237.

Color very variable from all black through black with brown maculations, brown with black mottlings to all brown; abdominal tergites with numerous scattered, small, sharp tubercles. Length of body, 18-26 mm.

In the United States the range of U. robusta extends westward from Minnesota and Illinois to Idaho, Utah, Texas, and New Mexico. Individuals spend the day hiding in loose soil but will leave their retreat in cloudy weather or wander about during the darker hours of the evening and night.

Judging from the number of specimens which appear each year in student collections this must be the commonest member of the family in the vicinity of Ames and probably in the western half or more of the state. Nymphal material had been collected between March 6 and June 24, adult material from June 14 to August 17. This species has also been listed for the state under its current name by Osborn (98), Scudder (134), Ball (2), Hendrickson (71), and Knutson and Jaques (86).

Adair, Cedar, Des Moines, Dubuque, Floyd, Harrison, Henry, Iowa, Johnson, Keokuk, Lee, Louisa, Mills, Monona, Muscatine, Page, Polk, Pottawattmie, Poweshiek, Scott, Story, Wapello, and Woodbury counties.

Family GRYLLIDAE¹ Latreille

1810 GRYLLIDES Latreille, Considérations Générales, p. 245.

Head robust, usually perpendicular or nearly so, vertex rounding smoothly into face; eyes small, rounded or oval, widely separated;

¹This family name is retained because Opinion 104 of the International Commission on Zoological Nomenclature placed Gryllus on the Official List of Generic Names in Zoology with Gryllus (Acheta) campestris Linnaeus as genotype. The generic name is therefore still available as pointed out by Gurney (43) for forming the family name; and the newer names, Achetidae and Gryllulidae, are unnecessary.

antennae usually long, filiform; pronotum broad, more or less flattened above; tegmina and wings variable from present and fully developed to absent, when well developed tegmina flattened above and directed abruptly downward laterally; wings folded fanwise; hind femora usually greatly enlarged; hind tibiae spined apically and on one or two dorsal margins; tarsi three-segmented; cerci very long, tapering, hairy; ovipositor of two valves, one dorsal, one ventral.

In habits the crickets are normally quite secretive. Many of the species are nocturnal and remain hidden during most of the day. Consequently, most of the normal activities of feeding, courting, and mating are carried on after dark. Feeding by some forms is definitely non-selective, plant and animal matter whether dead or alive is avidly consumed; in other forms definite preference is evidenced. Courtship by the crickets frequently includes a "song" performed by the males. The apparatus for producing sounds consists of a roughened vein on the top of one or both tegmina which may be rubbed against a hardened plate which is present on the wing above it. The vibration of the tegmina thus produced causes the sound—which is usually characteristic for the species producing it. The chirping of the crickets comprises one of the most conspicuous of the night-sounds heard during the summer months. Both Fulton (32) and Pierce (103) gave results of studies on these songs. After mating, the female usually deposits her eggs in the ground while a few species insert them in plant tissue. The egg stage is the most common hibernating condition for local species; only one of our species is known to pass the winter in the nymphal stage.

Six of the seven North American subfamilies are represented by Iowa records while one other probably also occurs here.

Key to the Subfamilies of GRILLIDAE in Iowa

1. Body subspherical (Fig. 26); tegmina and wings absent; hind tibiae armed above with only a few large movable spines MYRMECOPHILINAE p. 325
Body elongate, subcylindrical; tegmina and wings (in our species) present in various degrees of development 2
2. Tarsi compressed, segment II minute, compressed 3
Tarsal segment II distinct, heart-shaped 5
3. Head short, vertical or nearly so; hind tibiae above with large spines but lacking small teeth between them; color brown or black 4
Head elongate, horizontal; hind tibiae above with or without long spines if present then with numerous fine serrations between them; color green or faded to yellow . . . OECANTHINAE p. 318
4. Hind tarsus with segment I flat above, finely serrate along either edge; no prominent black bristles on body and legs GRILLINAE p. 312
Hind tarsus with segment I rounded above, not serrate; body and legs with prominent black bristles . . . NEMOBIINAE p. 315
5. Hind tibiae lacking serrations between spines on upper surface. TRIGONIDIINAE p. 323
Hind tibiae with serration between spines on upper surface ENEOPTERINAE p. 324

Subfamily GRYLLINAE Latreille

1810 GRYLLIDES Latreille, *Considérations, Générales*, p. 245.

Robust, stout form; pronotum wider than long, hind margin vaguely convex; tegmina and wings variable in length; femora unarmed, hind ones quite stout; hind tibiae with subapical spurs.

The two genera of this subfamily that are known to occur in Iowa may be separated by the couplet given below.

Key to the Genera of GRYLLINAE in Iowa

1. Hind tibiae more than three-fourths as long as hind femora. .
 Acheta p. 312
- Hind tibiae not more than two-thirds as long as hind femora. .
 Miogryllus p. 314

Genus Acheta Linnaeus

1785 Gryllus Acheta Linnaeus, *Syst. Nat. Edt. X.* 1:428.

Head subglobose, vertex more than twice as wide as basal antennal segment; pronotum rounded into lateral lobes which are longer than deep and have lower margin straight; hind tibiae with five to eight spines on each upper margin; apex of first segment of hind tarsus armed with a long stout spine on either side, inner one longer; front tibiae with tympanum on both outer and inner surfaces; ovipositor enlarged apically, not toothed.

Genotype: Gryllus (Acheta) domesticus Linnaeus.

The two included species known from the United States - one native, one an established adventive - formerly went under the generic name Gryllus. However, as Roberts (128) has pointed out, these forms are not congeneric with the type species of Gryllus (G. campestris) and so cannot be retained in that genus.

Key to the Species of Acheta in Iowa

1. Color dark brown or black; head without interantennal pale mark.
 A. assimilis p. 312
- Color yellow brown; head with prominent transverse interocular
 and interantennal crossbars A. domesticus p. 314

Acheta assimilis (Fabricius)

1775 Gryllus assimilis Fabricius, *Syst. Ent.* p. 280.

1868 Acheta abbreviata Walsh and Riley, *Am. Ent.* 1:53.

1877 Gryllus abbreviatus Bessey, 7th Bienn. Rept. Ia. State Coll. p. 206.

1892 Gryllus abbreviatus Osborn, *Proc. Iowa Acad. Sci.* 1(2):119.

1897 Gryllus abbreviatus Ball, *Proc. Iowa Acad. Sci.* 4:236.

1897 Gryllus luctuosus Ball, *Proc. Iowa Acad. Sci.* 4:236.

1897 Gryllus pennsylvanicus Ball, *Proc. Iowa Acad. Sci.* 4:236.

1901 Gryllus abbreviatus Scudder, *Psyche* 9:292.

1901 Gryllus pennsylvanicus Scudder, *Psyche* 9:292.

1915 Gryllus assimilis Rehn and Hebard, *Proc. Acad. Nat. Sci. Phila.* 67:309.

1930 *Gryllus assimilis* Hendrickson, Iowa State Coll. Jour. Sci. 4:63.

1935 *Gryllus assimilis* Knutson and Jaques, Proc. Ia. Acad. Sci. 42:184.

Body black, appendages variously colored from nearly wholly black to entirely brownish; head rarely more than slightly wider than pronotum, sometimes strongly swollen in some males; pronotum one and a half to two times as wide as long; tegmina variable in length, covering half or more of abdomen or strongly surpassing its apex; wings even more variable in length, may be reduced to mere pads, maybe slightly shorter than tegmina or may distinctly surpass apex of tegmina; hind tibiae with three pairs of unequal spines at apex; anal cerci tapering, nearly as long as hind femora. Length of body, 13-22 mm. (Fig. 28).

The range of the "field cricket" is very extensive in the western hemisphere extending from Argentina north into the southern half of Canada. Except for the more arid part of this area in which it does not occur, this cricket may be found in fields, meadows, and woods as well as inside of buildings.

The variability of form and color indicated in the above characterization has led to the naming of many combinations of these characters. The general conclusion reached by most modern workers concerning these named forms may be expressed by the statement of Rehn and Hebard (121), "They constitute mere variations, the adaptation of this exceedingly plastic species to local environmental conditions." But Fulton (33) believed this to be an "oversimplification" of the problem. He reported that in all the northern states in which this species has been studied "two single brooded seasonal races occur, one wintering as nymphs and the other as eggs." In North Carolina he found four races "distinguished by one or more physiological characters such as type of song, choice of habitat, or seasonal history." These races showed a tendency to retain their own seasonal history, but when this was varied experimentally it was found that the races were inter-sterile and incapable of producing offspring. Gurney (43) acknowledged Fulton's work but wrote, "these races are not satisfactorily separated by the usual taxonomic characters of a morphological nature, and since names have not been applied to them, it is advisable to continue using, for the present, the name *Acheta assimilis* in a broad sense." Subsequently Fulton (34) presented a historical review of the problem and more data on it. In that study he concurred with the conclusion that morphological determination of specimens was not yet possible, but pointed out that "some intrinsic isolating mechanism apparently exists, which prevents fertilization or the formation of a viable zygote.

The several hundred eggs are said to be laid in irregular masses in the soil. In Iowa, at least part of the population of this species passes the winter as young nymphs. These immature individuals hibernate under debris such as logs, rocks, and leaf of humus piles. During the more favorable periods of spring, summer and autumn the nymphs frequent the same places during the days and forage for food at night. Available specimen-records indicated that nymphs may be found during every month of the year. The adults are usually also present under these same conditions from the last part of May until the frosts of the following fall. Although ordinarily considered to be nocturnal in habits, this species was found quite active in the dense shade of weed patches and corn fields. In the

corn fields it was seen to move about freely and feed on corn pollen on the surface of the ground. Its food is quite varied and may consist of plant or animal matter. The latter included dead or injured insects, even of its own species. Appreciable damage may be done to garden crops by the feeding of the field cricket.

Adair, Adams, Allamakee, Appanoose, Boone, Buchanan, Cerro Gordo, Clarke, Clay, Clayton, Crawford, Dallas, Davis, Decatur, Des Moines, Dickinson, Floyd, Fremont, Greene, Hamilton, Harrison, Henry, Howard, Iowa, Jackson, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Madison, Marion, Mills, Montgomery, Muscatine, Osceola, Page, Plymouth, Polk, Pottawattamie, Ringgold, Scott, Shelby, Sioux, Story, Taylor, Union, Van Buren, Washington, Wayne, Winneshiek, and Woodbury counties.

Acheta domesticus Linnaeus

1758 Gryllus Acheta domesticus Linnaeus, Syst. Nat. Edit. X. 1:428.

1935 Gryllus domesticus Knutson and Jaques, Proc. Ia. Acad. Sci. 42:184.

Color yellow to yellowish-brown, yead with four pale crossbands, one each across occiput, between eyes, between bases of antennae and across the labrum, the latter two sometimes joined; pronotum with irregular dorsal spots and lateral bars reddish-brown; tegmina nearly or quite reaching apex of abdomen, wings either shorter or considerably longer than tegmina; ovipositor one-fifth longer than hind femora, its apex darkened. Length of body, 15-16.5 mm.

Blatchley (8) gives the range of this introduced Old World cricket, commonly called the "house cricket," as "probably occurs sparingly in most of the states east of the Rocky Mountains." At least in the northern states it frequents buildings during most of the year but does establish itself out-of-doors during the mild weather of summer.

It feeds on many substances around buildings and has been reported damaging fabrics, particularly wet ones.

Available Iowa specimens indicated that A. domesticus entered Iowa before 1935, as reported by Knutson and Jaques (86), and that it began to increase in abundance, at least in Ames, by 1953 when a number of specimens were included in student collections. These insects had been captured in homes and campus buildings.

Clinton, Henry, Polk, and Story counties.

Genus Miogryllus Saussure

1877 Miogryllus Saussure, Mem. Soc. Phys. et Nat. Hist. de Geneve, 25:194.

Robust; vertex more than twice as wide as basal antennal segment; pronotum short, subquadrate, front margin feebly convex, hind one truncate; tegmina and wings variable, in macropterous forms wings considerably longer than tegmina, in brachypterous forms reduced to small pads; female tegmina with veins definitely longitudinal; legs short, stout, front tibiae with inner tympanum absent or obsolete in brachypterous forms; hind tibiae with four to five spines on each upper margin; ovipositor longer than hind femora, enlarged apically and not toothed.

Genotype: Gryllus pusillus Burmeister.

Of the five species recognized by Hebard(47) only one occurs in Iowa.

Miogryllus verticalis (Serville)

1839 Gryllus verticalis Serville, Hist. Nat. Ins. Orthop. p. 343.

Color variable from darkbrown to almost wholly black; occiput usually shining black with a narrow yellow stripe above each eye and two shorter ones in middle; pronotum blackish, mottled with paler, lateral lobes abruptly dull yellow on lower third or more; abdomen dark brown to black, usually with a row of vague pale blotches either side of midline; head wider than front margin of pronotum; latter about three-fifths as long as wide; tegmina of females usually but little longer than pronotum (rarely macropterous) and scarcely touching along sutural margins, of males covering at least three-fourths of abdomen and broadly overlapping. Length of body, 11-17 mm.

The present, widely distributed species ranges from New Jersey to Florida and west to Nebraska, Kansas, Oklahoma, and Texas. It is a ground-dwelling species which conceals itself under leaves, rocks and other objects of fields and open woods.

In addition to the literature record of Knutson and Jaques (86) two specimens were available from Story County. These had been collected between May 17 and August 1.

Cedar, Henry, Johnson, Marion, Muscatine, Story, and Van Buren counties.

Subfamily NEMOBIINAE Hebard

1913 NEMOBIITES Hebard, Ent. News 24:451.

Robust, stout form; pronotum short, subquadrate, front and hind margins truncate; tegmina and wings variable in length; femora unarmed, hind ones quite stout; hind tibiae with dorsal spurs long, movable and pilose, subapical spurs also present.

A single genus is represented in the Iowa fauna.

Genus Nemobius Serville

1839 Nemobius Serville, Hist. Nat. Ins. Orthop. p. 345.

Lower front angles of lateral lobes rounded; front tibiae with "ear" present on inner surface only; hind tibiae armed above with four spines on each margin and with three subapical spurs on both outer and inner faces; basal segment of hind tarsus spined at apex, inner lateral spine longer than outer one.

Genotype: Acheta sylvestris Bosc.

Of the approximately one dozen species known from the United States, five have been collected in Iowa while one more may be found.

Key to the Species of Nemobius¹ in Iowa

¹Soudder's (142) Iowa record of N. cubensis was probably based on a misidentification as that species is not known to occur in the mid-continental United States.

1. Hind tibiae with lower pair of apical spines of equal length. 2
Hind tibiae with lower pair of apical spines of unequal length. 3
2. Last two segments of palpi white, immaculate . . . N. confusus p. 318
Last two segments of palpi white, apical one distinctly black-
ened at tip N. carolinus carolinus p. 318
3. Lateral lobes of pronotum either wholly black or with broad
black vitta above pale lower margin; ovipositor straight,
at least as long as hind femur 4
Lateral lobes of pronotum not so marked, at most with dark mott-
lings on light brown background; ovipositor strongly curved,
about two-thirds as long as hind femur N. bruneri p. 317
4. Eyes surrounded (except ventrally) by prominent, pale, . . .
suffused ring; hind femora usually with several large dark
blotches which (from above) create the impression of a pale
subapical annulus N. maculatus p. 317
Eyes not ringed with pale; hind femora without dark blotches, only
markings above being pale spots behind bases of erect spines. 5
5. Face below antennal insertions a uniform shining black
. N. griseus griseus p. 317
Face below antennal insertions not a uniform black, distinctly
paler toward ventral margin N. fasciatus p. 316

Nemobius fasciatus (DeGeer)

1773 Gryllus fasciatus DeGeer, Mem. Ins. 3:522.

1877 Nemobius vittatus Bessey, 7th Bienn. Rept. Ia. State Coll. p. 206.

1892 Nemobius vittatus Osborn, Proc. Iowa Acad. Sci. 1(2):119.

Color variable, ranging from pale reddish-brown through fuscous to nearly wholly black; vertex with or without longitudinal stripes; tegmina usually somewhat paler, variable in length, either reaching to or nearly tip of abdomen or, as in some females, not surpassing middle of abdomen; wings also dimorphic, either twice as long as tegmina or reduced to mere pads; ovipositor at least as long as hind femora. Length of body, 7.5-11.5 mm. (Fig. 22).

The known range of N. fasciatus extends from southern Canada to the Gulf states and west to Manitoba, Utah, and New Mexico. Although a number of categories less than a species have been recognized with a name (the woodland race N. tinnulus was described in part from Iowa by Fulton (31)) many of these were simply color variations or responses to differences in habitats. Fulton (31) concluded from intensive studies that some of these were "physiological subspecies" and "that morphologically they have not diverged far enough to make exact classification possible. For this reason I see no reason why any of these crickets should not be referred to merely as Nemobius fasciatus in any general discussion where fine distinctions are not involved." The present work definitely falls into this category so no more effort will be made to separate these vaguely separable forms.

As thus understood the species occurs in all types of environments from stream sides to dry fields and from meadows to woods. It appears to be as common on city lawns as is Acheta assimilis (Fabricius) and is often attracted to lights in great numbers. Adult specimens were at

hand for the period from July 20 to October 30, indicating that the species is active until the advent of killing frosts; nymphal material showed second and third instars present as early as June 25, the latest nymphal record was for August 21. Iowa records were also published by Scudder (135), Ball (2), Hebard (46), Hendrickson (70, 71), Fulton (31), Hebard (59), and Knutson and Jaques (86).

Boone, Buena Vista, Cedar, Clay, Clayton, Davis, Delaware, Des Moines, Dickinson, Emmet, Franklin, Fremont, Hamilton, Hancock, Harrison, Henry, Howard, Iowa, Jackson, Johnson, Kossuth, Lee, Louisa, Lyon, Mitchell, Monona, Muscatine, Osceola, Palo Alto, Plymouth, Polk, Sioux, Story, Union, Van Buren, Washington, Winnebago, and Woodbury counties.

Nemobius griseus griseus Walker

1904 Nemobius griseus Walker, Canadian Ent. 36:182.

Reddish-brown body color covered with fine, short, closely appressed gray or brown hairs; vertex dull yellow with three fuscous stripes. Tegmina in male covering basal three-fourths or more of abdomen, in female more than half as long as hind femur; wings absent; ovipositor much longer than hind femur. Length of body, 6.8–8.2 mm.

This northern race is known to occur in eastern North America from Maine to Connecticut west through Ontario to Minnesota and northern Illinois and south to southern Indiana. It is usually found in sandy areas that have a sparse cover of vegetation.

Although unrepresented in local collections, the general range as given above indicates that this subspecies may occur in the eastern part of the state.

Nemobius bruneri Hebard

1913 Nemobius bruneri Hebard, Proc. Acad. Nat. Sci. Phila. 65:452.

Color clay yellow, mottled with brown; face below antennae shining blackish-brown; dorsum of abdomen shining black on basal half; tegmina translucent, upper lateral field with a blackish stripe; dorsum frequently spotted or mottled with dark brown; tegmina of male reaching tip of abdomen, of female covering only basal half; wings absent or reduced to minute pads; ovipositor about two-thirds as long as hind femora, slightly curved. Length of body, 6.4–9.4 mm.

The range of this small cricket is northern, extending from Maryland west to Nebraska and south to North Carolina and Kansas. It occurs in moist situations along streams and in woods.

In addition to the recording by Knutson and Jaques (86), two specimens collected in Henry County on September 12 were available for study.

Nemobius maculatus Blatchley

1900 Nemobius maculatus Blatchley, Psyche 9:52.

Color dark brown with yellowish suffusion and numerous piceous dots; lateral lobes of pronotum with a broad black stripe above pale lower margin; lateral field of tegmina in great part fuscous, its dorsal vein in male conspicuously yellowed; tegmina of males about two-thirds as long as abdomen, of females about half as long; ovipositor about as long as hind femora. Length of body, 6.5–9 mm.

This cricket occupies a range from Canada and New York west to Iowa and south and west to Georgia, Tennessee, and Missouri. It can be found in dry open woods and along the borders of thickets.

Except for a single specimen labelled June 24, 1897, all available specimens had been collected between August 3 and October 12. Literature listings of this species for Iowa were given by Hebard (55) and Knutson and Jaques (86).

Boone, Cedar, Delaware, Fremont, Henry, Iowa, Johnson, Story, and Van Buren counties.

Nemobius confusus Blatchley

1903 Nemobius confusus Blatchley, Rept. Ind. Dept. Geol. 27:421.

General color uniformly shining piceous, legs paler; tegmina of males reaching tip of abdomen, of females only half as long; ovipositor slightly more than half as long as hind femora, slightly curved, its apex armed with teeth above and below. Length of body, 5.7-7.3 mm.

This cricket has been reported from Maryland, Virginia, North Carolina and Illinois. It frequents low, damp woods, especially in the vicinity of bodies of water.

The small series available for study had been collected during July and September.

Fremont and Henry counties.

Nemobius carolinus carolinus Scudder

1877 Nemobius carolinus Scudder, Proc. Boston Soc. Nat. Hist. 19:36.

Head, pronotum and femora pale brown to blackish-brown, lateral field of tegmina darkened on upper half, dorsal field of male translucent; dorsum of abdomen in female with three rows of yellow spots; tegmina of male reaching to tip of abdomen, of female only about halfway; ovipositor slightly more than half as long as hind femora, apex toothed above and below. Length of body, 5.7-7.3 mm.

The nominal race, the only one occurring in Iowa, ranges widely from Ontario and Nova Scotia south to Florida and west from the Atlantic Coast to Minnesota, Nebraska, and Texas. As recorded by Walker (150), "It frequents low grounds of almost any kind, but delights especially in low grassy borders of swampy woods or clearings in swamps."

In Iowa it is not uncommon between the dates of August 12 and October 17. Ball (2), Hebard (46), and Knutson and Jaques (86) listed it for the state.

Clay, Clayton, Dallas, Delaware, Dickinson, Henry, Johnson, Monona, Osceola, Polk, and Story counties.

Subfamily OECANTHINAE Saussure

1874 OECANTHITES Saussure, Miss. Sci. Mexique et Am. Centr. Orthop. p. 428.

Head elongate, nearly or quite horizontal, vertex declivent, rounded into front; eyes ovate, oblique; antennae more than twice as long as body, two basal segments much enlarged; pronotum longer than broad, narrowed anteriorly; angles of lateral lobes rounded; tegmina of males flattened,

horizontal, much wider than abdomen, tips broadly rounded; wings usually longer than tegmina; females with tegmina membranous, much narrower than in male, usually held closely against sides of body, often shorter than wings; front and middle legs slender, not spined, tibiae dilated near base; front tibiae with an elongate tympanum on either side; hind femora slightly swollen with three pairs of unequal spines at apex; male subgenital plate elongate, scoop-shaped, rounded at apex; ovipositor straight, shorter than hind femora, outer valves with short blunt teeth.

The life history of Oecanthus, which has been intensively investigated by a number of workers, probably is characteristic for both local genera of the subfamily. In brief it is as follows: the male, in "singing," raises its tegmina at right angles to the body and exposes a gland, the secretion of which is very attractive to the female. As she climbs over the male's body to feed on the secretion he inserts the spermatophore into her body. When the female prepares to lay her eggs she first chews a pit in the outer covering of the plant and with a series of quick thrusts inserts the ovipositor through this pit into the tissue of the plant. After laying the eggs she withdraws the ovipositor and plugs the hole with bits of chewed bark or excrement. The winter season is passed in the egg stage, the young not hatching until the following spring.

Fulton (29a) pointed out that the food of these crickets consists of both plant and animal matter, depending on which is most available. They cause some damage by chewing holes in fruits, but will also feed on leaves, floral parts, and fungi. The injury they do while feeding on plant tissue may in part be offset by their feeding on easily captured soft bodied insects such as plant lice and scale insects.

Both genera known to occur in the United States have been collected in Iowa.

Key to the Genera of OECANTHINAE in Iowa

1. Hind tibiae above with minute teeth between bases of longer spines;
antennal I simple, not tuberculate beneath . . . Oecanthus p. 319
- Hind tibiae above with neither minute teeth nor longer spines;
antennal I with a prominent polished tubercle on lower surface
(Fig. 116) Neoxabea p. 323

Genus Oecanthus Serville

1831 Oecanthus Serville, Ann. Sci. Nat. 22:134.

Maxillary palpus with segment four about as long as three; tegmina of female regularly reticulate, oblique veins distinct; hind tarsi imperfectly four-segmented, basal segment longer than others combined and with a single spur on either side at apex; anal cerci slender, straight, almost as long as abdomen.

Genotype: Gryllus pellucens Scopoli.

Of the seven United States species recognized in literature, five are known to occur in Iowa. However, Fulton (29, 29a) has shown that some of these nominal species represent groups of what are possibly physiological, incipient, or sibling species.

Key to the Species of Oecanthus in Iowa

1. Antennals I and II with black marks on lower side 2
 Antennals I and II without black marks on lower side; front of head
 and bases of antennae usually suffused with pink.
 O. latipennis p. 321
2. Antennals I and II each with a single black mark (Figs. 119, 120). 3
 Antennals I and II each with two black marks, these sometimes
 coalesced into irregular blotches (Figs. 122, 123) (see p. 322
 for key to subspecies) O. nigricornis p. 321
3. Antennal I with an elongate black mark (Figs. 120, 131). 4
 Antennal I with a rounded black dot similar to that of II (Fig. 119)
 O. niveus p. 320
4. Black mark of antennal I straight, that of II a rounded dot
 (Fig. 120). O. exclamationis p. 321
 Black mark of antennal I J-shaped, that of II an elongate rounded
 dot (Fig. 121). O. angustipennis p. 320

Oecanthus niveus (DeGeer)

1773 Gryllus niveus DeGeer, Mem. L'Hist. Nat. Ins. 3:522.

Whitish to very pale green; top of head and basal segments of antennae often suffused with orange-yellow; pronotum almost as wide as long; male tegmina broad, width half as great as length, not or but slightly surpassed by tip of wings; in female, wings exceeding tegmina by 3-5 mm. Length of body, 12-14.5 mm.

The "snowy tree cricket" is the most widely distributed North American tree cricket. It ranges from Maine, Ontario, and British Columbia south to Georgia and Mexico into Central America. It is a bush and tree inhabitant. Fulton (29) reported on this species in some detail. Eggs are deposited singly in the bark of trees or in berry cane at the sides of the axils of the leaves. In the latter it differs from O. nigricornis which lays its eggs in rows of closely placed eggs along the internode of the cane.

July 29 and October 30 were extremes of dates appearing on specimens studied. Listings of local occurrence were given by Bessey (6), Osborn (98, 99), Ball (2), and Knutson and Jaques (86).

Boone, Cedar, Clarke, Dickinson, Emmet, Guthrie, Henry, Mahaska, Polk, Story, and Woodbury counties.

Oecanthus angustipennis Fitch

1856 Oecanthus angustipennis Fitch, Trans. N.Y. St. Agr. Soc. 16:413.

Pale greenish-white; vertex and base of antennae often yellowed; tegmina of male slightly less than half as wide as long, transparent and faintly greenish; wings slightly surpassing apex of tegmina in both sexes. Length of body, 11.5-14 mm.

The general range includes the area from Massachusetts south to Florida and west to South Dakota, Kansas, and Texas. Tall weeds and the shrubs and trees of woods' borders comprise the preferred habitat.

Osborn (98), Ball (2), and Knutson and Jaques (86) listed this species as occurring in Iowa. Available adult specimens have been taken during the period between August 8 and November 11.

Boone, Cedar, Henry, Johnson, Linn, Sioux, Story, and Woodbury counties.

Oecanthus exclamationis Davis

1907 Oecanthus exclamationis Davis, Canadian Ent. 39:173.

Pale greenish-white, occiput and vertex sometimes pale to orange-yellow; male tegmina distinctly less than half as wide as long; wings in both sexes decidedly surpassing apices of tegmina. Length of body, 12-15 mm.

The present tree cricket has been reported from Connecticut, New York, North Carolina, Ohio, Tennessee, Iowa, and Missouri. It occurs most commonly in oak trees.

The single pair available for study was collected in Henry County on August 22, 1924. Knutson and Jaques (86) listed the species for the state.

Oecanthus latipennis Riley

1881 Oecanthus latipennis Riley, U.S. Ent. Comm. Bull. 6, p. 61.

Greenish- to yellowish-white, occiput and basal part of antennae frequently washed with reddish; tegmina of male about half as wide as long, the veins of the hyaline area usually faintly bordered with fuscous; wings of male not surpassing apex of tegmina, of female distinctly exceeding them. Length of body, 13-17 mm.

This cricket occurs from New York west to South Dakota and south to Georgia, Oklahoma, and Kansas. It frequents vines and thickets, especially those along woods borders.

In addition to the listings by Osborn (98), Ball (2), and Knutson and Jaques (86), there were available records from three specimens collected in Story County during August of the years 1891 and 1897 and one taken on September 4, 1935 in Muscatine County by King.

Oecanthus nigricornis Walker

1869 Oecanthus nigricornis Walker, Catal. Dermaptera Saltatoria, 1:93.

1892 Oecanthus fasciatus Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Oecanthus fasciatus Ball, Proc. Iowa Acad. Sci. 4:236.

Color variable from nearly wholly pale greenish-yellow to greenish with head, middle and lateral stripes on pronotum, center of abdomen and nearly entire legs black; tegmina of male slightly less than one-half as wide as long; wings slightly to distinctly surpassing apices of tegmina in both sexes. Length of body, 12-14 mm.

With its various color forms or subspecies characterized below, this species extends across southern Canada and the northern United States from the Atlantic to the Pacific and south to North Carolina, Missouri, and Texas.

An extended study made on this species by Parrot and Fulton (100) and Fulton (29a) showed that certain color forms of this had decided preferences as to habitat and host plants for oviposition as well as marked differences in the structure of their eggs. From the extensive observations in the field and in the laboratory Fulton (29a) concluded that although in certain parts of the range these forms are distinct enough to be considered

separate species, the specimens from intermediate areas serve as intergrades; and although these differences are probably genetic it is best to consider the forms all as subspecies of one widely ranging species. Remarks about each will be made below.

Key to the Subspecies of Oecanthus nigricornis in Iowa

1. Marks on antennal I more weakly developed, separated by a space at least as wide as the widest of them (Fig. 123). O. quadripunctatus p. 323
- Marks on antennal I heavier, separated by less space, often confluent (these two forms run very close together) (Fig. 122). 2
2. Color (typically) pale, never with decided black markings listed below O. argentinus p. 322
- Color (typically) with head and pronotum unifasciate, trifasciate or wholly black; abdominal sternites fuscous or black O. nigricornis p. 322

Oecanthus nigricornis nigricornis Walker

1869 Oecanthus nigricornis Walker, Catal. Dermaptera Saltatoria 1:93.

This is typically the darkest and most heavily marked of the three subspecies. Fulton (29a) wrote that it is the most northern, reaching the southern states only in the Appalachian region and ranging west to the prairie states where the color characteristics become less distinct but the egg structure remains constant. However, in the eastern Great Plains it intergrades with subspecies O. nigricornis argentinus which has very similar eggs.

The preferred habitat and hosts for oviposition of the "black-horned tree cricket" are berry canes and tall rank weeds or bushy undergrowth of more woody plants. This is the tree cricket which causes so much damage to berry canes by inserting its eggs into them. The canes above the inserted eggs often die and may break off.

Typical material of this is less common in Iowa than for the other two subspecies. Adults studied had been collected during the season from August 5 to October 18. The subspecies was reported for the state by Osborn (98), Hebard (51), Hendrickson (71), and Knutson and Jaques (86).

Black Hawk, Boone, Clay, Clayton, Davis, Dickinson, Dubuque, Emmet, Grundy, Henry, Iowa, Johnson, Lee, Louisa, Lucas, Lyon, Montgomery, Monroe, Muscatine, Osceola, Palo Alto, Plymouth, Polk, Ringgold, Sioux, Story, Taylor, Washington, Wayne, Winnebago, and Woodbury counties.

Oecanthus nigricornis argentinus Saussure

1897 Oecanthus argentinus Saussure, Biol. Centr. Am. Orth. p. 253.

This subspecies (Fig. 23) apparently represents a pallid western form which merges with typical nigricornis in the central United States and occupies the range westward to the Pacific coast. Its host preference is for weeds or shrubs one to three feet high.

Material studied had been collected between July 12 and October 18. Hendrickson (71) and Knutson and Jaques (86) listed the form for Iowa.

Clay, Des Moines, Dickinson, Emmet, Fremont, Henry, Iowa, Johnson, Lee, Louisa, Lyon, Muscatine, Page, Plymouth, Pottawattamie, Shelby, Story, Van Buren, Wapello, Washington, Wayne, and Woodbury counties.

Oecanthus nigricornis quadripunctatus Beutenmuller

1894 Oecanthus quadripunctatus Beutenmuller, Bull. Am. Mus. Nat. Hist. 6:250.

1928 Oecanthus quadripunctatus Hendrickson, Ann. Ent. Soc. Am. 31:133.

Fulton's work (loc. cit.) showed the "four-spotted tree cricket" to be very distinct from typical O. nigricornis in the eastern part of the United States but to intergrade with it in the central part. This intergradation is common in Iowa material, but locally this form appears to be the most common of the three. July 17 and October 14 were extremes of dates represented in the large series examined. Local occurrence of this form was published by Hendrickson (70, 71) and Knutson and Jaques (86).

Audubon, Benton, Boone, Buena Vista, Clay, Clinton, Dallas, Davis, Des Moines, Dickinson, Greene, Hamilton, Hardin, Henry, Jackson, Kossuth, Lee, Linn, Louisa, Mahaska, Marion, Muscatine, Palo Alto, Polk, Sioux, Story, Taylor, Van Buren, Warren, Washington, Wayne, Winnebago, and Woodbury counties.

Genus Neoxabea Kirby

1906 Neoxabea Kirby, Synon. Catal. Orthop. 2:76.

Maxillary palpi with fourth segment about half as long as third; tegmina of female irregularly reticulate, oblique veins inconspicuous; hind tarsi three-segmented, basal segment without spurs at apex, second segment very short; anal cerci stout, sinuate, half as long as abdomen.

Genotype: Gryllus bipunctatus DeGeer.

The type and only North American species of the genus has been found in Iowa.

Neoxabea bipunctata (DeGeer)

1773 Gryllus bipunctatus DeGeer, Mem. L'Hist. Nat. Ins. 3:523.

1892 Xabea bipunctata Osborn, Proc. Iowa Acad. Sci. 1(2):119.

1897 Xabea bipunctata Ball, Proc. Iowa Acad. Sci. 4:237.

Color yellowish or pale pinkish-brown, tegmina of females each with a sub-basal and submedian fuscous blotch; antennae not marked with black on basal segments, the tooth on underside of first segment usually darkened; sides of fastigium carinate. Length of body, 13-16 mm.

The range of this rare cricket covers much of the southern United States north to Connecticut and Iowa and west to Kansas. It frequents densely tangled vines in and around woods and so is seldom collected.

The few specimens studied had been taken between July 9 and October 17, with three fully matured nymphs on August 24. Knutson and Jaques (86) also listed it for the state.

Clayton, Henry, Johnson, Story, and Van Buren counties.

Subfamily TRIGONIDIINAE Saussure

1874 TRIGONIDIENS Saussure, Miss. Sci. Mex. et l'Am. Centr. Orthop. p. 361.

Head large, subquadrate, at least as wide as pronotum; antennae three or more times as long as body; eyes rounded, separated by at least twice their own diameters; pronotum without lateral carinae, anterior and posterior margins subtruncate; tegmina slightly surpassing tip of abdomen in male, almost reaching it in female; wings, when fully developed, longer than tegmina; hind femora unarmed beneath; hind tibiae above with three pairs of long, movable spines and at apex with two inner and three outer spurs.

One of the genera is to be found in Iowa.

Genus Anaxipha Saussure

1874 Anaxipha Saussure, Miss. Sci. Mex. et l'Am. Centr. 6:370.

Head vertical, front declivent and protuberant between bases of antennae; eyes subrounded, deeper than long; last segment of maxillary palpi longer than preceding, apex dilated and truncate; pronotum broader than long, with many erect stiff hairs; wings absent or twice as long as tegmina; legs pubescent, anterior tibiae with tympanum on both sides in winged forms, on outer side only in wingless ones; spines of hind tibiae usually much longer than the space between their bases.

Genotype: Acheta exigua Say.

One species occurs in this state.

Anaxipha exigua (Say)

1825 Acheta exigua Say, Jour. Acad. Nat. Sci. 4:236.

1897 Anaxiphus pulicarius Ball, Proc. Iowa Acad. Sci. 4:236.

Dull brownish or clay yellow, face generally streaked and spotted with black; hind femora usually (especially in males) with a fuscous vitta on lower half of outer face; spines of hind tibiae with bases and apices embrowned. Length of body, 5-7 mm. (Fig. 25).

The range of this insect is from Connecticut south to Florida and west to Minnesota, Nebraska, and Texas. It is to be found most commonly among plants bordering marshes, swamps, and lakes.

In writing of it on Iowa prairies Hendrickson (71) said that adults and nymphs occurred at Spartina consocias. Knutson and Jaques (86) also listed it for the state. Local specimens examined were collected between July 30 and September 4.

Clayton, Johnson, Muscatine, Story, and Woodbury counties.

Subfamily ENEOPTERINAE Saussure

1878 ENEOPTERIENS Saussure, Mem. Soc. Phys. et Nat. Hist. de Geneve 25:194.

Head at least as wide as prothorax, vertex and face oblique, meeting at a distinct prominent angle between bases of antennae; pronotum subquadrate; tegmina usually not reaching apex of abdomen; wings present usually wholly concealed by tegmina; legs stout, front tibiae with tympanum on inner face only; hind femora moderately swollen, hind tibiae above with two rows of large movable spines and small teeth between them, at apex with three long inner and three short outer spurs; subgenital plate of

male conical, scoop-shaped; cerci long, slender, tapering; ovipositor subcylindrical, slightly upcurved.

This group of crickets has received the common name of bush-crickets because they frequent shrubbery and low trees, particularly in moist areas.

Of the three genera that occur in the United States only one ranges as far north as Iowa.

Genus Hapithus Uhler

1864 Hapithus Uhler, Proc. Ent. Soc. Phila. 2:546.

Head subglobose, narrower than base of pronotum; maxillary palpi with last segment enlarged at tip and obliquely truncate, its length one-third greater than preceding segment; pronotum short, gradually widened posteriorly.

Genotype: Hapithus agitator Uhler.

A single species has been found in Iowa.

Hapithus agitator agitator Uhler

1864 Hapithus agitator Uhler, Proc. Ent. Soc. Phila. 2:546.

1897 Apithes agitator Ball, Proc. Iowa Acad. Sci. 4:236.

Color dull brownish or reddish-brown with a vague to distinct yellow stripe following lateral edge of dorsal field of tegmina; latter usually reaching nearly or quite to apex of abdomen, wings generally absent (in local material). Length of body 9-14 mm. (Fig. 20).

The known range extends from New York west to Nebraska and south and southwest to Florida and Texas. The preferred habitat is in dense tangles of vines and shrubby undergrowth in moist woods.

Although the race undoubtedly will be found across the southern part of the state, only a single specimen-record was at hand for Lee County. Knutson and Jaques (86) listed it for the state.

Subfamily MYRMECOPHILINAE Saussure

1874 MYRMECOPHILIENS Saussure, Miss. Sci. Mex. et l'Amer. Centr. Orthop. p. 428.

Head inserted into pronotum, occiput and very small eyes covered; vertex rounded, strongly declivent; face much narrowed by very large antennal sockets; antennae as long as body, basal segment very large; pronotum longer than meso- and metanotum, its lateral lobes much longer than deep; meso- and metanota similar in appearance to abdominal segments but slightly longer; front and middle legs slender, former without tympanum on tibiae; hind femora ovate, compressed, its height more than half its length; hind tibiae shorter than the femora, curved, with two pairs of slender spurs at apex, upper pair longer; cerci long, tapering; male with subgenital plate boat-shaped, deeply cleft; ovipositor short, stout, straight.

As suggested by the name of this subfamily, the members of this group of crickets are usually found with or near ants. Apparently any species of ant satisfies the wants of these crickets because they are not closely associated with any particular one. These "wants" seem to consist chiefly of the surface exudates of the host which may still cover the body of the

ant or be rubbed off onto the walls of their galleries. The crickets are usually able to nibble the oily covering of the ant with little resentment on the part of the host. But if the ant does become irritated by the feeding the cricket must jump away quickly to avoid the dog-like snap of the ant's large mandibles. The size of the cricket is, apparently, dependent upon the size of the ants in whose galleries it develops - the larger crickets developing with the larger ants.

The subfamily embraces a single genus which is world-wide in its distribution.

Genus Myrmecophila Latreille

1829 Myrmecophila Latreille, Le Reg. Ani. etc. Orthop. 2nd Ed. 3:183.

This genus, sufficiently characterized by the key and the subfamily description above, was treated by Hebard (50) and includes four species in the United States. Only one of these is known to occur as far east as Iowa.

Genotype: Blatta acervorum Panzer.

Myrmecophila pergandei Bruner

1884 Myrmecophila pergandei Bruner, Canadian Ent. 16:42.

Color reddish-brown, darkened along hind margin of each body segment, upper surface sometimes marked with yellow; base of antennae, legs and cerci paler; body depressed, bearing very short, reclined, yellowish bristles; hind tibiae with four spines on inner dorsal margin alternating in length; first segment of hind tarsi with three spinules on median dorsal margin. Length of body, 3-4.3 mm. (Fig. 26).

This ant-loving cricket occurs in the eastern United States from Maryland to Florida and west to Kentucky and Nebraska. It is usually collected from ant galleries that come to the surface of the ground under rocks, logs, and other debris.

Although not yet known from the state, the above outlined range indicates that further collecting in the southern part of the state will probably find it.

Family GRYLLOTALPIDAE Leach

1815 GRYLLOTALPIDA Leach, Edinburg Encycl. 9:119.

Body and legs stout, covered with fine short pubescence; head small, sunken into prothorax; antennae shorter than body; eyes very small; two ocelli present; pronotum subcylindrical, arched, its hind margin broadly rounded and slightly produced; tegmina subtriangular, usually abbreviated and not reaching apex of abdomen; wings fully developed, surpassing apex of abdomen, or variously reduced but always surpassing tegmina; abdomen cylindrical, apex obtuse; ovipositor concealed.

The mole-cricket, as members of this family are commonly called, burrows mole-like through the moist mud and sand which form the banks of ponds and streams. The burrows or runs so produced are usually just below the surface and are indicated above ground by a low ridge of soil similar to that produced by the mammal after which it is named. The insects are reported to be able to move either forward or backward in these tunnels. The food of these creatures is made up chiefly of tender roots of various plants encountered during their burrowing. They may

eat the roots of cultivated plants and so damage them. In the north central states there appears to be but a single generation each year, adults occurring in mid and late summer. Eggs are said to be glued to rootlets in side branches of the main tunnel.

One of the two known North American genera is to be found in Iowa.

Genus Gryllotalpa Latreille

1802 Gryllotalpa Latreille, Hist. Nat. Crust. et Ins. - Orthop. 7:275.

Front tibiae with four large flattened spurs apically, the upper two larger and movable, lower two rigidly fixed; hind tibiae without long stout spines on inner upper edge; basal segment of hind tarsi not spinose apically.

Genotype: Gryllus (Acheta) gryllotalpa Linnaeus.

One member of this genus has been collected in Iowa.

Gryllotalpa hexadactyla Perty

1832 Gryllotalpa hexadactyla Perty, Delect. Ani. Artic. Brasil p. 119.

1877 Gryllotalpa longipennis Bessey, 7th Bienn. Rept. Ia. State Coll. p. 205.

1892 Gryllotalpa borealis Osborn, Proc. Iowa Acad. Sci. 1(2):120.

1892 Gryllotalpa longipennis Osborn, Proc. Iowa Acad. Sci. 1(2):120.

1897 Gryllotalpa borealis Ball, Proc. Iowa Acad. Sci. 4:236.

1897 Gryllotalpa columbia Ball, Proc. Iowa Acad. Sci. 4:236.

Color various shades of brown, fine pubescence similarly colored; tegminal veins, claws and apices of dactyls darker; front trochanter short, nearly semicircular, clothed below with stout, bristle-like hairs; hind tibiae with eight apical spines, four longer ones on inner side and four shorter ones on outer; cerci nearly one-half longer than pronotum. Length of body (in our specimens) 26-34 mm. (Fig. 24).

The range occupied by this curious insect is very extensive, reaching from southern Canada south through the United States east of the Great Plains and thence into Texas and south to Brazil and Peru. Specimens are most commonly encountered under objects lying on the moist sand or mud banks in which the mole-cricket burrows.

The adults were represented by specimens that had been collected, some at lights, between May 18 and October 12; nymphs between April 15 and July 7. In the Iowa State College collection there is a specimen bearing the notation "Damaging Potatoes." The burrowing habits and root-feeding of this insect makes such damage not at all unlikely, especially if the potatoes had been grown in low, wet ground. Besides the numerous recordings listed above, Knutson and Jaques (86) also reported it for the state.

Buchanan, Butler, Davis, Fremont, Guthrie, Henry, Iowa, Keokuk, Jefferson, Johnson, Louisa, Lucas, Monroe, Page, Scott, Story, Tama, Wapello, Woodbury, and Wright counties.

Family TRIDACTYLIDAE Saussure

1874 TRIDACTYLITES Saussure, Miss. Sci. Mex. et l'Am. Centr. Orthop. p. 347.

Body smooth; ocelli three, small; antennae widely separated at base, with eleven segments elongate; pronotum short, not prolonged posteriorly; male tegmina without a tympanum; auditory slits absent from front tibiae; hind femora strongly swollen; abdomen with four apical, tapering appendages.

These pigmy mole-crickets burrow in the ground as do the larger gryllotalpids, but their activities are not confined to burrows in such a degree. Both immature and adult forms are to be found frequently on the surface of the soil or sand. They are equally at home on land or water and jump vigorously from either. In general, the biology of these insects is supposed to be similar to that of the larger mole-crickets, although nymphs and adults of one local species spend considerable time on the surface of the earth.

A single genus is known from Iowa and the United States.

Genus Tridactylus Olivier

1789 Tridactylus Olivier, Encycl. Method. Diction. Ins. 4:26.

Head subconical; ocelli in transverse row; pronotum strongly convex, hind margin broadly rounded; tegmina leathery, usually not reaching past middle of hind femora; wings reaching or surpassing apex of abdomen; legs compressed, front and middle pair each with two-segmented tarsi, hind tibiae slightly serrate above, with tarsus absent or one-segmented; cerci slender, upper pair two-segmented, lower pair one-segmented.

Genotype: Acheta digitata Illiger.

Specimens of two species have been collected within the state.

Key to the Species of Tridactylus in Iowa

1. Hind tarsus I-segmented; pronotum polished, with a weak,
transverse sulcus anteriorly. T. apicalis p. 328
- Hind tarsus absent; pronotum dull, without a transverse sulcus
. T. minutus p. 328

Tridactylus apicalis Say

1825 Tridactylus apicalis (!) Say, Jour. Nat. Sci. Phila. 4:310.

Color variable brown to black, occiput and pronotum with paler mottlings; tegmina paler dorsally, most of front legs and usually markings on outer face of hind femora pale; pronotum faintly constricted at apical fourth and with a faint median groove posteriorly. Length of body, 6-9.5 mm. (Fig. 27).

T. apicalis ranges widely from Ontario and New England west to Minnesota and south to Florida, southwest to California, and through Mexico into South America.

The small series of local specimens studied had been collected during April, May, and June but the form should occur as adult the year around. Say (loc. cit.) described this species in part from material collected "on the Missouri River, as far as Council Bluffs." Osborn (98), Ball (2), and Knutson and Jaques (86), reported it for the state.

Boone, Hamilton, Henry, Iowa, Johnson, Story, and Van Buren counties.

Tridactylus minutus Scudder

1862 Tridactylus minutus Scudder, Jour. Boston Soc. Nat. Hist. 7:425.

General color black or dark brown; head, pronotum, tegmina, and legs mottled with yellow or cream; tegmina half as long as abdomen; wings slightly to greatly passing tips of tegmina, sometimes exceeding apex of abdomen. Length of body, 4-5 mm.

This little sand cricket occurs generally in the United States east of the Great Plains and south from New Jersey, Ohio, Illinois, and South Dakota to Florida and Texas, while outside of this region it has been reported for Colorado and California.

It is a very common inhabitant of sand bars and banks along streams in Iowa. Adult records were available for the period from April through October; nymphal data for July and August. It was reported for the state in literature by Knutson and Jaques (86).

Boone, Clay, Clinton, Hancock, Henry, Johnson, Linn, Page, Palo Alto, Polk, Sioux, Story, Van Buren, Wapello, Webster, and Worth counties.

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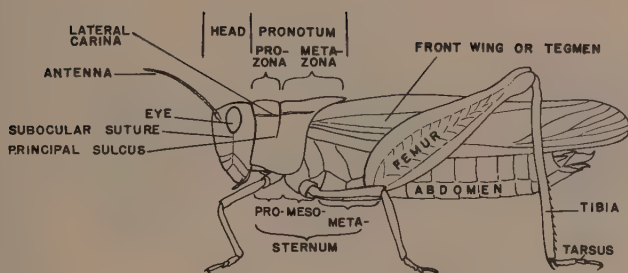
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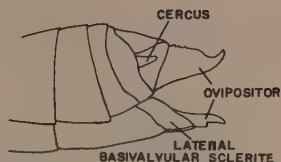
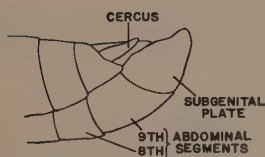
PLATE 1

Structural Details of a Typical Orthopteron

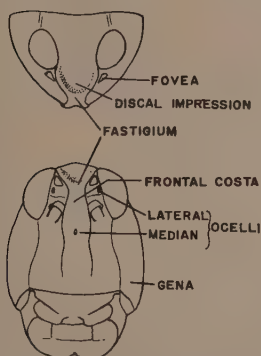
Diagram of a grasshopper showing most of structural details referred to in the present paper.



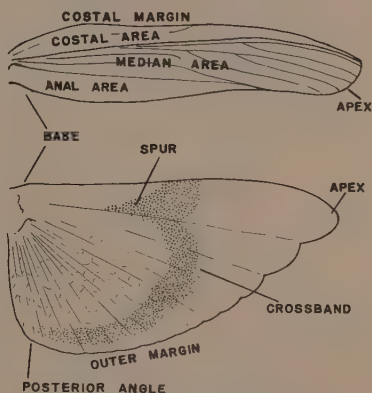
LATERAL VIEW OF GRASSHOPPER



APICES OF ABDOMEN OF MALE (LEFT) FEMALE (RIGHT) GRASSHOPPER



HEAD OF A GRASSHOPPER
DORSAL (ABOVE) AND ANTERIOR VIEWS



FRONT AND HIND WINGS
OF GRASSHOPPER

PLATE 2

Representatives of the Families Blattidae, Mantidae, and Phasmidae

Fig. 1. Blatta orientalis (female)

Fig. 2. Blatta orientalis (male)

Fig. 3. Pycnoscelus surinamensis

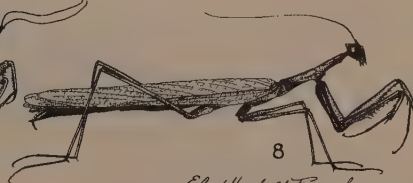
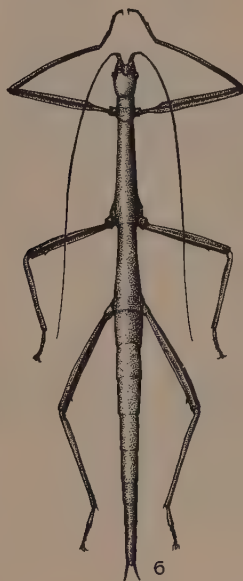
Fig. 4. Parcoblatta pennsylvanica (female)

Fig. 5. Parcoblatta pennsylvanica (male)

Fig. 6. Diapheromera velii velii

Fig. 7. Litaneutria minor

Fig. 8. Oligonicella scudderi



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PLATE 3

Representatives of the Families Tetrigidae and Acrididae

Fig. 9. Paratettix cucullatus cucullatus

Fig. 10. Tettigidea lateralis

Fig. 11. Pardalophora apiculata with wings of opposite side raised and spread to show pattern.

Fig. 12. Melanoplus mexicanus mexicanus

Fig. 13. Syrbula admirabilis

Fig. 14. Brachystola magna



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Ellis Herbold Froeschner

PLATE 4

Representatives of the Family Tettigoniidae

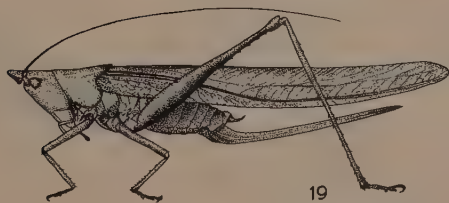
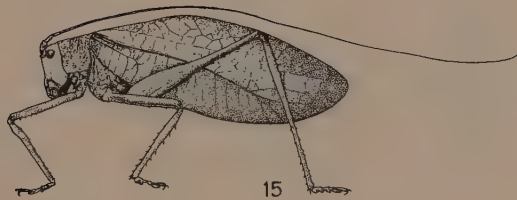
Fig. 15. Pterophylla camellifolia camellifolia

Fig. 16. Pediodectes nigromarginata

Fig. 17. Conocephalus strictus

Fig. 18. Scudderia furcata furcata

Fig. 19. Neoconocephalus robustus crepitans



Elmer Herbert Froeschner

PLATE 5

Representatives of the Families Gryllacrididae, Gryllidae,
Gryllotalpidae and Tridactylidae

Fig. 20. Hapithus agitator agitator

Fig. 21. Ceuthophilus seclusus

Fig. 22. Nemobius fasciatus

Fig. 23. Oecanthus nigricornis nigricornis

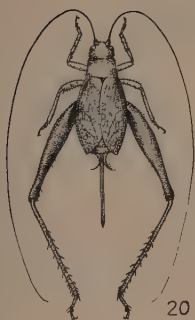
Fig. 24. Gryllotalpa hexadactyla

Fig. 25. Anaxipha exigua

Fig. 26. Myrmecophila pergandei

Fig. 27. Tridactylus apicalis

Fig. 28. Acheta assimilis



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PLATE 6

Structural Details of the Families Blattidae,
Mantidae, Tetrigidae, and Acrididae

Fig. 29. Parcoblatta pennsylvanica anterior femur, anterior view.

Fig. 30. Blattella germanica anterior femur, anterior view.

Fig. 31. Parcoblatta uhleriana cercus, ventral view.

Fig. 32. Parcoblatta pennsylvanica subgenital plate of male, ventral view.

Fig. 33. Stamomantis carolina face, anterior view.

f.p. = facial plate.

Fig. 34. Oligonicella scudleri anterior coxa, inner view.

Fig. 35. Nomotettix parvus head and pronotum, lateral view.

Fig. 36. Nomotettix cristatus compressus pronotum, lateral view.

Fig. 37. Nomotettix cristatus cristatus pronotum, lateral view.

Fig. 38. Tetrix ornatus head, dorsal view.

Fig. 39. Tetrix subulatus head, dorsal view.

Fig. 40. Schistocerca americana americana prosternum, ventral view.

Fig. 41. Melanoplus walshii tegmen.

Fig. 42. Melanoplus rusticus obovatipennis tegmen.

Fig. 43. Chortaphaga viridifasciata tegmen.

c = costal area

m = median area

d = dorsal area

Fig. 44. Orphulella pelidna pelidna head, dorsal view.

Fig. 45. Orphulella speciosa head, dorsal view.

Fig. 46. Ageneotettix deorum deorum head, dorsal view.

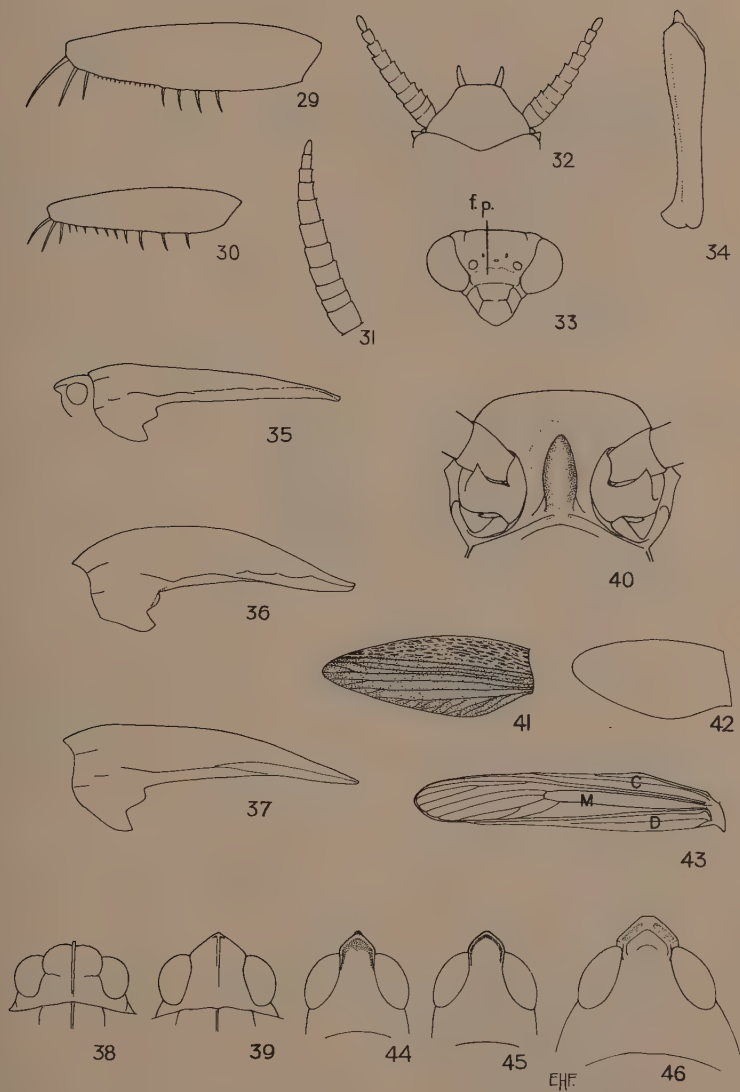


PLATE 7

Structural Details of the Family Acrididae

Fig. 47. Encoptolophus sordidus sordidus pronotum, lateral view.

Fig. 48. Arphia xanthoptera pronotum, lateral view.

Fig. 49. Dendrotettix quercus mesosternum, ventral view.

Fig. 50. Schistocerca americana americana mesosternum, ventral view.
l.l. = lateral lobe

Fig. 51. Melanoplus differentialis last abdominal tergite and supra-anal plate, dorsal view.

Fig. 52. Melanoplus foedus fluviatilis last abdominal tergite and supra-anal plate, dorsal view.

Fig. 53. Melanoplus mexicanus mexicanus apex of abdomen, dorso-lateral view.

c = cercus

sa = supra-anal plate

f = furcula

sg = subgenital plate

Fig. 54. Melanoplus angustipennis last abdominal tergite and supra-anal plate, dorsal view.

Fig. 55. Melanoplus impiger last abdominal tergite and supra-anal plate, dorsal view.

Fig. 56. Melanoplus scudderi scudderi cercus, lateral view.

Fig. 57. Melanoplus borealis junius cercus, lateral view.

Fig. 58. Melanoplus fasciatus cercus, lateral view.

Fig. 59. Melanoplus differentialis differentialis tips of dorsal and ventral valves of aedeagus, ventral view.

ca = cavity

ch = channel

Fig. 60. Melanoplus differentialis nigricans tips of right dorsal and ventral valves of aedeagus, ventral view. (abbr. as in Fig. 59)

Fig. 61. Orphulella speciosa dorsal valve of aedeagus, lateral view.

Fig. 62. Orphulella pelidna pelidna dorsal valve of aedeagus, lateral view.

Fig. 63. Melanoplus islandicus cercus, lateral view.

Fig. 64. Melanoplus gladstoni cercus, lateral view.

Fig. 65. Melanoplus bivittatus cercus, lateral view.

Fig. 66. Melanoplus differentialis cercus, lateral view.

Fig. 67. Melanoplus walshii cercus, lateral view.

Fig. 68. Melanoplus impiger cercus, lateral view.

Fig. 69. Melanoplus mexicanus mexicanus cercus, lateral view.

Fig. 70. Melanoplus foedus fluviatilis cercus, lateral view.

Fig. 71. Melanoplus punctulatus griseus cercus, lateral view.

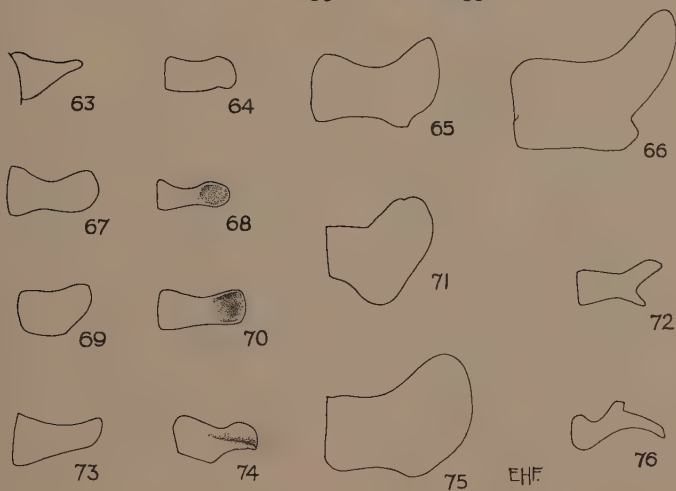
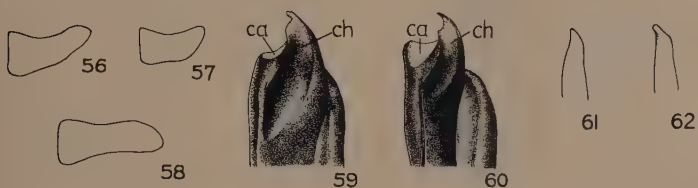
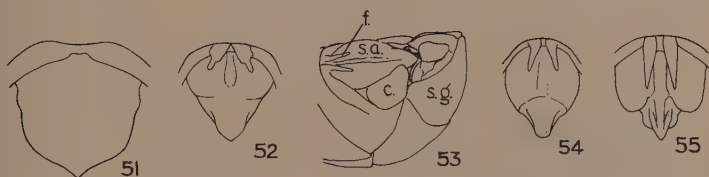
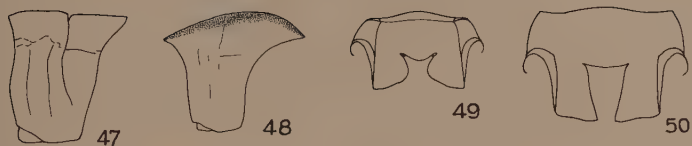
Fig. 72. Melanoplus keeleri luridus cercus, lateral view.

Fig. 73. Melanoplus femur-rubrum femur-rubrum cercus, lateral view.

Fig. 74. Melanoplus confusus cercus, lateral view.

Fig. 75. Melanoplus ponderosus viola cercus, lateral view.

Fig. 76. Melanoplus infantilis cercus, lateral view.



E.H.F.

PLATE 8

Structural Details of the Family Tettigoniidae

- Fig. 77. Microcentrum rhombifolium pronotum, dorsal view.
Fig. 78. Amblycorypha oblongifolia pronotum, lateral view.
Fig. 79. Scudderia texensis front tibia, lateral view.
Fig. 80. Pterophylla camellifolia camellifolia front tibia, lateral view.
Fig. 81. Orchelimum silvaticum ovipositor, lateral view.
Fig. 82. Orchelimum gladiator ovipositor, lateral view.
Fig. 83. Scudderia furcata abdominal process of male, dorsal view.
Fig. 84. Scudderia curvicauda curvicauda abdominal process of male, dorsal view.
Fig. 85. Scudderia pistillata abdominal process of male, dorsal view.
Fig. 86. Scudderia texensis abdominal process of male, dorsal view.
Fig. 87. Scudderia furcata furcata ovipositor, lateral view.
Fig. 88. Scudderia curvicauda curvicauda ovipositor, lateral view.
Fig. 89. Scudderia texensis ovipositor, lateral view.
Fig. 90. Scudderia pistillata ovipositor, lateral view.
Fig. 91. Orchelimum vulgare left cercus male, dorsal view.
Fig. 92. Orchelimum silvaticum left cercus male, dorsal view.
Fig. 93. Orchelimum gladiator left cercus male, dorsal view.
Fig. 94. Orchelimum volantum left cercus male, dorsal view.
Fig. 95. Orchelimum concinnum left cercus male, dorsal view.
Fig. 96. Orchelimum nigripes left cercus male, dorsal view.
Fig. 97. Conocephalus brevipennis left cercus male, dorsal view.
Fig. 98. Conocephalus attenuatus left cercus male, dorsal view.
Fig. 99. Conocephalus fasciatus fasciatus left cercus male, dorsal view.
Fig. 100. Conocephalus nemoralis left cercus male, dorsal view.
Fig. 101. Conocephalus strictus left cercus male, dorsal view.
Fig. 102. Conocephalus nigropleurum left cercus male, dorsal view.

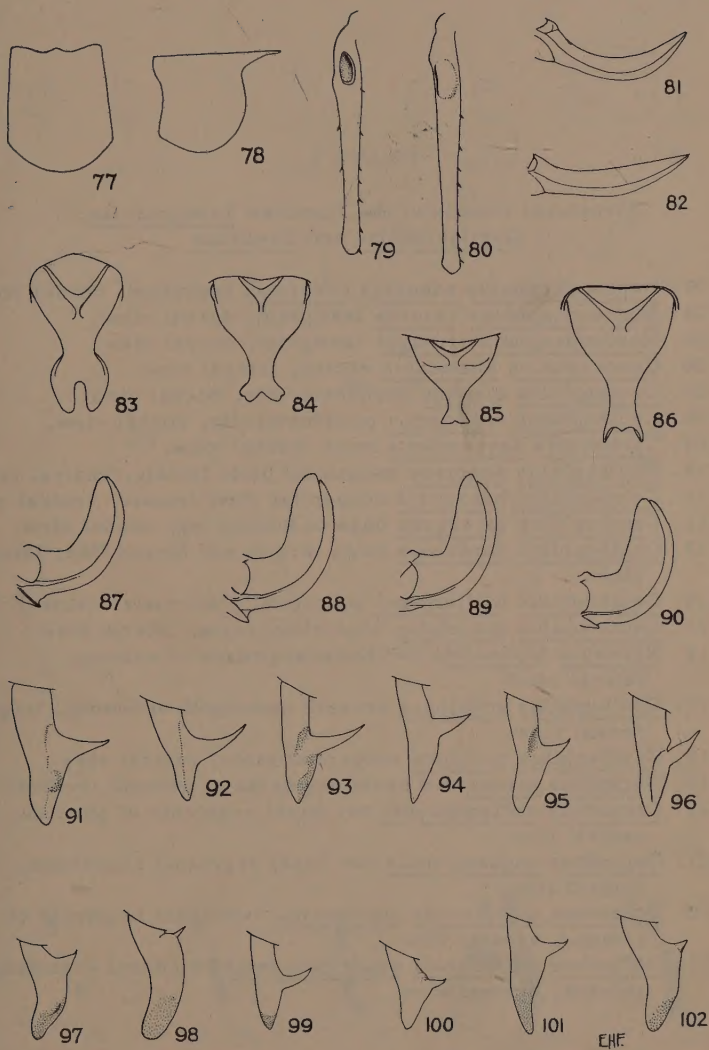
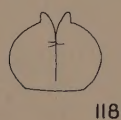
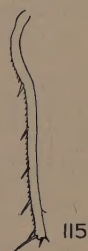
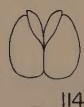
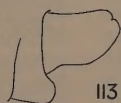
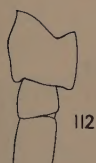
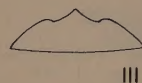
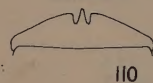
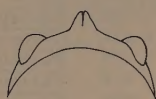
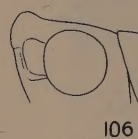
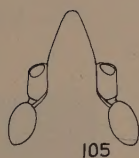
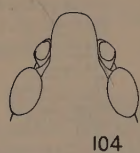
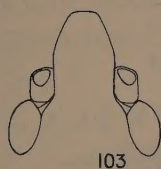


PLATE 9

Structural Details of the Families Tettigoniidae,
Gryllacrididae and Gryllidae

- Fig. 103. Neoconocephalus robustus crepitans fastigium, dorsal view.
Fig. 104. Neoconocephalus retusus fastigium, dorsal view.
Fig. 105. Neoconocephalus ensiger fastigium, dorsal view.
Fig. 106. Conocephalus attenuatus vertex, lateral view.
Fig. 107. Ceuthophilus elegans pseudosternite, dorsal view.
Fig. 108. Ceuthophilus fusiformis pseudosternite, dorsal view.
Fig. 109. Tachycines asynamorus head, dorsal view.
Fig. 110. Ceuthophilus seclusus subgenital plate female, ventral view.
Fig. 111. Ceuthophilus kansensis subgenital plate female, ventral view.
Fig. 112. Ceuthophilus divergens base of middle leg, caudal view.
Fig. 113. Ceuthophilus kansensis ninth tergite and hinged flap, lateral view.
Fig. 114. Ceuthophilus williamsoni subgenital plate male, ventral view.
Fig. 115. Ceuthophilus maculatus hind tibiae male, lateral view.
Fig. 116. Neoxabea bipunctata two basal segments of antenna, lateral view.
Fig. 117. Ceuthophilus nodulosus seventh and eighth abdominal tergites, dorsal view.
Fig. 118. Ceuthophilus brevipes subgenital plate, ventral view.
Fig. 119. Oecanthus niveus two basal segments of antenna, ventral view.
Fig. 120. Oecanthus exclamationis two basal segments of antenna, ventral view.
Fig. 121. Oecanthus angustipennis two basal segments of antenna, ventral view.
Fig. 122. Oecanthus nigricornis nigricornis two basal segments of antenna, ventral view.
Fig. 123. Oecanthus nigricornis quadripunctatus two basal segments of antenna, ventral view.



EHF



INDEX TO THE GENERA AND HIGHER GROUPS

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